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ABSTRACT

Six City Technology Colleges (CTCs) were all site selected, built, and opened in under 2 years without being compromised by expense or loss of quality. This document examines this "fast-track" method of building projects using case studies of each school that illustrate the CTC concept and process. The CTC initiative is described including discussions of its funding and ethos, educational characteristics and objectives, curriculum framework, building objectives, and project management concepts. The case studies explore the different forms of building contracts used (management forms, design and build, and measured term), furniture procurement methods, the school design development that supported the educational objectives, the inclusion of technology that met or exceeded the minimum requirements for technology and science, and the creation of a learning environment that supported cross curricular activity with increasing use of technology throughout the curriculum. Each case study includes floor plans and photographs. (GR)

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ED 431 302

BUILDING BULLETIN 72

EDUCATIONAL DESIGN INITIATIVES

in City Technology Colleges

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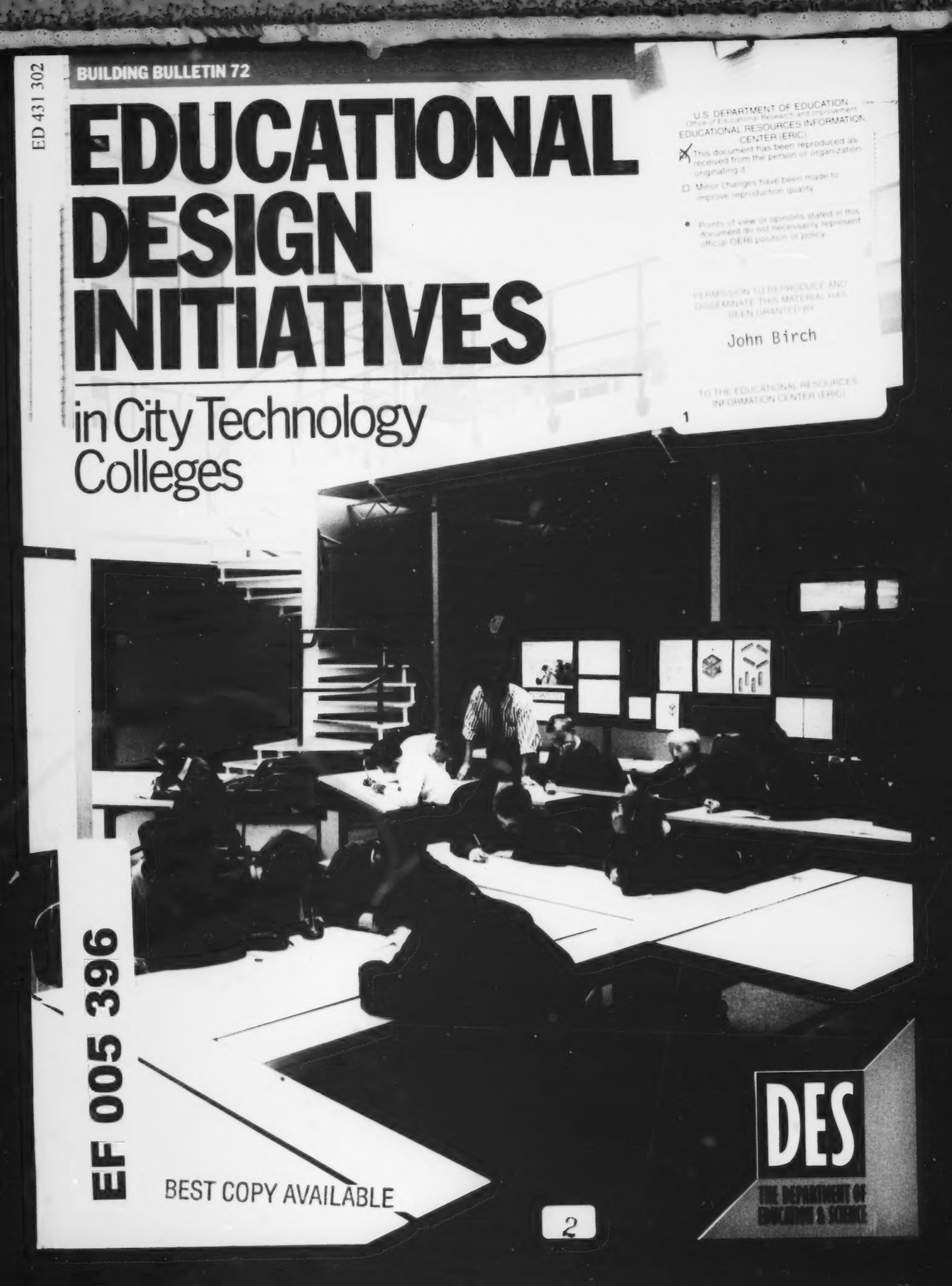

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THE DEPARTMENT OF EDUCATION & SCIENCE

EDUCATIONAL DESIGN INITIATIVES

in City Technology Colleges

A study of six schools for 11-18 year olds, having particular emphasis on technology and science.

LONDON: HMSO

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PREFACE

1. Following the completion of the first City Technology College (CTC) projects there has been considerable interest, both nationally and internationally, in the experiences of this innovative building programme which has aimed to inform briefing, design and construction for 11-18 schools. This publication, prepared by Architects and Building Branch of the Department of Education and Science, lays emphasis on building and accommodation aspects of the Educational Design Initiatives taken.

2. The format and content of this Building Bulletin is intended to appeal to all those who are involved in provision for 11 to 18 year old pupils. It should be of interest to educationalists, education officers, governors, sponsors, architects, quantity surveyors, engineers and all who might be involved in the LEA maintained, independent, voluntary aided and grant maintained sectors and the continuing CTC programme.

3. The Bulletin consists of a series of self contained chapters which start by explaining the context of the programme. This is followed by a description of six building projects presented as case studies, with an explanation of how they were carried out. Chapters follow which analyse - by illustration from the case study projects - design considerations, characteristics of key learning and ancillary spaces, and finally an analysis of the building services that support delivery of the curriculum.

4. The Building Bulletin has been prepared by a team of architects and others who have been closely involved in the whole programme, and particularly as project architects for the Djanogly College at Nottingham. Every opportunity has been taken to draw on the direct experiences, supplemented by visits to all the six colleges illustrated and discussion there with the principals, project directors and the architects involved. Considerable data has been supplied by the colleges and their design teams and this has been incorporated in comparative data sheets as a rich resource of information for those embarking on any 11-18 educational project. The illustration of three new-build projects and three predominantly remodelled projects is deliberate. The experience of adapting existing buildings, many of which will remain substantially occupied during the works, is one that most local authorities will share in the future. An illustration of how familiar problems were tackled at Kingshurst, Macmillan and Leigh colleges will therefore be helpful.

5. However the opportunities for educational planning innovation taken in a new, or partly new, building project, as illustrated by Kingshurst, Djanogly, Bradford and Emmanuel colleges, are critical in informing those considering projects of any type.

6. There is no attempt to assess the educational success of the projects as most are very new and none have yet reached capacity. However, every opportunity has been taken to comment on the experiences to date so that readers involved in the design and procurement of accommodation for 11 - 18 schools may form a judgement on a course of action that is most appropriate for them.

EXECUTIVE SUMMARY
Costs and Time

The six illustrated City Technology Colleges were all completed and open in under two years, from identifying the site to opening the college. This compares favourably with previous experiences of more than three years in the maintained educational sector where additional procedures often have to be followed. The benefits of speed were not compromised by expense or loss of quality. The average cost of the projects compares favourably with costs for schools in the maintained sector over the same period of time; and a high quality has been achieved throughout. Such 'fast-track' building projects stem from the forms of contract used.

- **'Management' forms** of contract for Kingshurst, Djanogly, Macmillan and Bradford suited new and remodelled projects equally well. They benefited from early contractor involvement, a quick start on site and the flexibility to finalise later construction packages as work progressed.
- **'Design and Build'** contracts for half of the Kingshurst College and Emmanuel College changed the traditional triangle of client, designers and contractor to just client and contractor. In these projects, cost and programme benefited whilst relying heavily on the experience of those professionals advising the client.
- A **'measured term'** contract for the remodelling of existing buildings at Leigh College suited a project where the full scope became clear as building progressed.

Furniture and Equipment

The **procurement** of furniture, equipment and consumables in a short space of time requires the services of a specialist agent to manage the process. A vigorous programme has resulted in a series of 'turn key' operations which are new in this country but have been used extensively abroad. Whilst budgets for building are traditionally separate from those for furnishing and equipping, the processes related to them are actually closely entwined. Roles and responsibilities must be clearly defined and regular dialogue established so that the themes of space planning and services design run coherently through the building to its furniture and equipment.

Design

The design of schools evolves from the curriculum requirements, with design solutions positively supporting the educational objectives. The buildings need an individual identity and character, but the changing nature of education calls for a flexible approach. Designing for change should distinguish elements of the building which will have a long life - structure, external fabric and services - from those which need to be replaced over a shorter timescale - partitions, furniture and equipment. These characteristics are exploited by **flexibility** using loose furniture and a mixture of spaces; and **adaptability** through the potential to easily modify internal space and services.

Technology and IT

All the CTCs provide for the National Curriculum and in many respects exceed the minimum requirements for technology and science. A common theme of all the projects is the grouping of Technology around a central resources area; an approach which suits the new definitions of 'Technology' covering craft, design, technology, food, business studies and information technology (IT). In addition to using **IT** in the classroom as part of curriculum teaching, there is an emphasis on more informal access outside the class, with pupils using IT as a tool for their independent project work.

Environment

Because of the changes in learning characteristics, the emphasis in cross curricular activity and increasing use of technology throughout the curriculum, greater demands are made on **environmental and workplace servicing.** A balance must be struck between a low technology approach which maximises the use of natural ventilation and lighting and demands for a range of sophisticated technology to control energy consumption; to safeguard occupants and equipment; and to provide support to the learning process and the acquisition of essential skills.

All these key themes are well illustrated in the following pages which describe this exciting and innovative programme.

THE CTC INITIATIVE

1. In 1986 the Secretary of State announced that the Government planned to establish a network of City Technology Colleges (CTCs) in urban areas. The first CTC, Kingshurst Solihull, opened in September 1988. Two more colleges opened in 1989, and four opened in 1990. Six others will open in 1991 and a further two in 1992. The programme is a part of the Government's Action for Cities Campaign, a series of co-ordinated initiatives seeking to persuade commercial and industrial interests to become involved in meeting community needs.

Funding and Ethos

2. This network of colleges is funded jointly by the Government and private business and industry, the latter providing a substantial proportion - at least 20% - of the capital funding for each of the colleges. The essential recurrent costs of CTCs are met by central government at a level comparable to that received by maintained schools in similar areas. In addition to offering parents a greater choice of schools, CTCs are intended to provide an example and a challenge for other schools to follow in the following ways:

- by raising students' and parents' expectations, leading to improved staying-on rates, examination performance and employment prospects;
- by attracting, motivating and retaining high quality staff;
- by promoting curriculum innovation in science and technology and by applying technology across the curriculum and in school management;
- by involving business and industry directly in running the schools; and
- by fostering an ethos of commitment, motivation and success.

Each of the colleges is established under an independent Trust with charitable status. The Trust, formed by groups of sponsors or their representatives, and the Secretary of State, owns the college and secures its operational independence through a legally binding funding agreement with Central Government. This independence is designed to give them greater freedom to experiment. The colleges' governors are drawn predominantly from commerce and industry in order to create a climate for fresh thinking about educational programmes.

Educational Characteristics

3. As their name implies, the colleges are sited in inner city and urban areas. They charge no fees. Their students are between the ages of 11 and 19 and reflect a broad range of abilities. They are drawn from a defined catchment area, and are chosen to be as representative as possible of the area which the CTC services. Parents are asked to give an undertaking to keep their children in education or training until the age of eighteen.

Educational Objectives

4. CTCs are committed by their funding agreements to provide the National Curriculum. They are encouraged to develop a curriculum which forges links between subjects and tackles those aspects of the curriculum which do not fall neatly within the ambit of a particular subject, for example economic awareness, business understanding, personal and social education.

Curriculum Framework

5. However, within this broad framework the colleges are free to develop their own curricular philosophy. City Technology Colleges emphasise science and technology, and in all colleges between 30% and 40% of the week is devoted to the study of these two areas. The emphasis on technology also pervades the other subjects of the curriculum. Additionally, in all CTCs the use of Information Technology (IT) enhances the whole curriculum. This has been made possible by extensive provision of IT hardware and software throughout individual colleges, with the intention of exploring its value and effectiveness in supporting educational objectives.

Other areas to receive particular emphasis in CTCs are business studies, and foreign languages.

Longer Working Day

6. The colleges work a longer day and year than most other schools and some

are experimenting with a five term year. The longer day allows the CTCs to provide time for enrichment activities for all pupils, which encompass the whole range of experiences that have traditionally been offered after school as extra-curricular activities. In all CTCs there is a strong emphasis on self discipline and positive attitudes by students which shows itself in the methods of working and the variety of activities and groupings seen in and out of the classrooms.

7. Those colleges which have already opened are developing differing approaches to their task; for example, in the pattern of the school day and year; in the general management structure of the college; in the design and management of the curriculum and the enrichment activities, and in the methods of introducing the use of IT into the curriculum. Many of the individual characteristics of the CTCs arise from the local circumstances and the community in which the college is placed. As the colleges develop, local needs, both commercial and communal, are likely to continue to influence the curricula and ethos of the colleges. These same influences have, in some cases, also brought a strong local identity to the design of the buildings, such as a reflection of the local vernacular style.

BUILDING OBJECTIVES

8. One of the key concerns of the CTC initiative has been the need that the colleges should be enabled to open as quickly and cost effectively as possible. This has led to the application of 'fast-build' techniques. These techniques involve factors relating both to building technology and construction, and to methods of management for the design and build process.

9. Previous experience in the maintained sector has been that it takes at least three years and usually more to progress from capital approval to a school opening. Fast build techniques mean that the same programme can be achieved within a period of 15 months to 2 years. Timescales such as these are clearly advantageous in many respects, especially against a background of inflation in the building industry running at twice the national rate.

10. Such timescales are common in the industrial and commercial sector, so from the beginning suitable contract methods were available.

11. However, there has been little experience of applying these techniques to educational building, with its complexity of space types and variable levels of servicing; and their use for the CTC programme has broken new ground. At the same time there was a need to demonstrate good value for money and to keep within an overall capital cost comparable to that of new-build maintained sector schools in inner city areas. A number of approaches have been followed and some of these are described in the individual case studies later on.

Project Management

12. The individuality of each college is encouraged by the way each building project is established. Project Directors are appointed by the local CTC Trust in consultation with the CTC Unit in the DES. The Project Director takes overall responsibility for appointing a team of consultants to deliver a building. This includes academic advisors, management and accounting consultants and the team of building professionals. Advice and support from DES is given by HM Inspectors and the Architects and Building Branch, through the CTC Unit, to the Project Directors.

Briefing Guide

13. In order to establish guidelines for the many consultants involved in the programme, both the educational advisors and the building professionals, a 'briefing guide' was developed by Architects and Building Branch based on the experiences of the first projects. This has reinforced the basis of the original funding, which for capital is closely aligned to LEA schools once account is taken of the particular factors influencing the programme - such as the emphasis on science and technology. Similarly, colleges will receive a level of recurrent grant based on provision in maintained schools in a similar area.

Furniture and Equipment Procurement

14. A major part of establishing these 11 to 18 colleges is putting in place, on time, sufficient furniture and equipment so that the college can open on the due date and commence a full educational programme. This has required the development of furniture and equipment procurement contracts similar to those used for the building. These are also considered in the case studies and some discussion of the different techniques used are explored later.

KINGSHURST CTC
Solihull

1. Kingshurst CTC was the first of the colleges to open and has therefore become a trend-setter for the whole programme. This is the only example built in two distinct construction phases but as such it is very similar to the experiences common in the LEA secondary sector. The site is 24 acres of the former combined girls and boys

Fig. 1: Location Plan

school of Kingshurst in Solihull. Following detailed surveys, a decision was taken to substantially remodel the four storey concrete frame building that had once been the boys school, as the first phase of the CTC; this was completed in September 1988. The second phase, completed in September 1990, is substantially a newly built two storey piece of accommodation which links in to the existing building at ground floor level.

Phase 1 Design Strategy

2. The refurbished first phase of existing buildings accommodate the new entrance hall, which leads to the main assembly hall on one side and the four storey block on the other. A variety of science, technology, IT and Art spaces are accommodated here, interspersed with general teaching rooms. The science laboratories are serviced using the 'Labkit' system*, designed to easily fit into existing buildings. The single storey extension has a less linear form, and houses an open-plan technology area.

Fig. 2: Site Plan

* see page 63

CASE STUDY DATA-SHEET
KINGSHURST CTC,SOLIHULL: PHASE I

College Principal
Mrs Valerie Bragg
Project Director
Mr Richard Tufft (Project Executive)
Main Contractor
Miller Construction Ltd
Architect
Ellis Williams Partnership
Services Consultant
S.I Sealy & Associates
Structural engineers
Ove Arup Associates, Birmingham
Quantity Surveyors
Coy Stevens & Associates
Furniture procurement
Griffin & George

Type of Building	100% refurbishment
Type of Contract	Management Contract
Total Capacity	400 pupils
First year intake	180 pupils
expected Post 16 intake	N/A
Area of site (phases 1 & 2)	4.9 ha
Area of existing building	4115m²
TOTAL GROSS AREA	4622m²
	11.56m² per pupil
Total teaching area	2564m²
	55% of gross
TOTAL BUILDING COST	£ 1,902,281
	£ 446 per m²

CASE STUDY DATA-SHEET
KINGSHURST CTC,SOLIHULL: PHASE II

College Principal
Mrs Valerie Bragg
Project Director
Mr Richard Tufft (Administration and finance)
Client's Consultant
A & B Branch and Coy Stevens & Associates
Main Contractor
Wimpey Construction (UK)
Architect
Leonard J Multon & Partners
Services Consultant
Drake & Scull Engineering Ltd
Structural engineers
Roy Bolsover & Associates
Furniture procurement
By college through various suppliers

Type of Building	100% new build
Type of Contract	Design and Build Contract
Total Capacity	1100 pupils
First year intake	180 pupils (completed college)
expected Post 16 intake	200 pupils over 2 years
Area of site (phases 1 & 2)	4.9 ha
Area of existing building	4622m² (phase I)
TOTAL GROSS AREA	8952m²
	8.14m² per pupil
Total teaching area	5647m²
	63% of gross
TOTAL BUILDING COST	£ 3,047,631
	£ 624 per m² (phase II only)

Fig. 3: Disposition of spaces diagram, showing phase I and II

The entrance foyer seen from the dining area.

3. Circulation in the four storey block originally emphasised use of the horizontal corridors connecting the existing stair towers. The first phase conversion opened teaching spaces visually, by glazed walls, and sometimes physically onto these corridors. This arrangement encourages pupils and staff to select the appropriate staircase to gain access to spaces rather than needlessly walking past or through teaching areas. It also usefully provides small study areas for unsupervised groups of between three and twelve pupils.

4. The range of accommodation in the first phase was required to meet the full curriculum needs of the first two years' intake of 180 pupils each year. It was therefore necessary for spaces initially designated for specialist use to be flexible, so that their change of use could be achieved at minimal cost and inconvenience when the second phase was completed.

5. The area next to the hall was used for dining in Phase I, then altered to staff and office accommodation when the new administration and library block was built.

The welcoming main entrance leads to the central entrance foyer.

Kingshurst Timescale

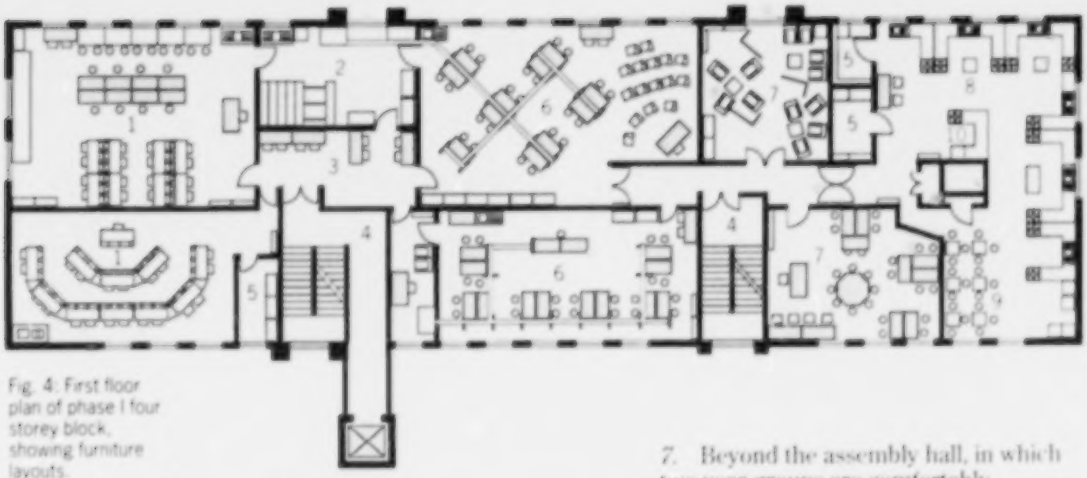


Fig. 4. First floor plan of phase I four storey block, showing furniture layouts.

Key

1. Science/ Technology Laboratory
2. Preparation
3. Social/Shared Work Area
4. Lift and Stairs
5. Store
6. Relocatable 'Labkit' Science Laboratory
7. General Teaching Rooms
8. Food Preparation
9. Textiles/ Seminar
10. Teacher's Demonstration Desk

In both phases, shared work areas are used for unsupervised learning, with computer resources.

The library, built as a new extension in phase II, has its own community entrance.

View across the internal courtyard to the dining area and hall; the re-clad four storey block is in the background.

Phase II Design Strategy

6. The **Library,** located in the new block at the front of the college, has its own external entrance. This demonstrates the emphasis on community use that has developed as a strong ethos of the college. This desire to give prominence and separate external access to the library has resulted in it being more remote from the main college accommodation - internal access being along a narrow administration corridor.

7. Beyond the assembly hall, in which two year groups are comfortably accommodated, is the existing gymnasium and changing rooms. These link with new changing rooms and a sports hall built in Phase II.

8. Corridors created within the existing buildings to avoid the assembly hall, link the entrance foyer with the sports hall and the north end of Phase II. They continue through the new Phase II building, creating a circulatory route around the central courtyard. The addition of a lift to each phase of development gives the disabled person

Phase I open-plan technology area, showing computer lathes and central, glazed design space.

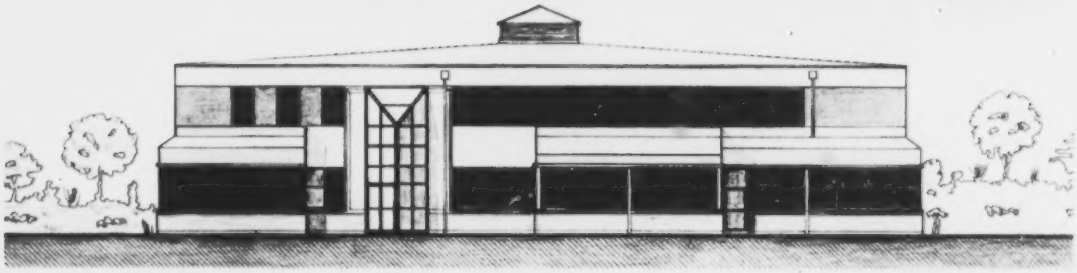


Fig. 5: Southwest elevation of phase II

complete access to the whole curriculum.

9. The bulk of the new block contains a variety of spaces including science, design technology, general teaching rooms, IT, languages, International Centre and business studies, music and stores. These rooms surround a large central drama space, mechanically ventilated and artificially lit. This is linked back to the first phase building via the single storey dining and kitchen area, which opens into the entrance hall.

10. **Small study** areas are provided at Kingshurst by a number of alcoves or bays along circulation routes in both phases of the building. These are frequently occupied by groups of pupils working unsupervised, often with computers.

Organisation

11. The organisation of the college under the Principal reflects the way accommodation has been disposed around the buildings. Rather than adopting the more traditional approach of keeping related subjects together, each group of spaces has been divided up into three 'areas', each with its own manager. The reason for this is to emphasise cross-curricular links.

Area 1 *Languages and Communication* - English, languages, music, drama, art, graphics, design and IT.

Area 2 *Maths, Enterprise and Human Studies* - maths, history, geography, RE, economics, business understanding, leisure, travel and tourism.

Area 3 *Science and Engineering* - crafts, sports, science, textiles, nursery nursing and caring, food technology and engineering buildings.

12. The **management structure** of the college consists of the Principal, a Director of Administration and Finance, a Commercial and Industrial Liaison Officer, the three curriculum "area" managers and managers for technology and one for post-16 teaching.

13. **Technician** support is not specific to any of the three "areas" and is organised to operate across the curriculum. Each group of facilities have their own preparation areas as demanded by the individual subject and the constraints of the relationship of accommodation.

14. **Enrichment activity** is incorporated into the working week. There are four one-hour enrichment periods every week, one of which should be related to sport and one curriculum based - such as the international language links. All years work together in enrichment periods. The day starts at 8.20am with breakfast served after the second lesson. The day normally finishes at 4.00 - 4.30 pm, with a shorter day on Friday.

15. **Post-16 provision** has been planned carefully during the first two years and the first students entered in September 1990. They can select from a wide range of vocational courses and the more academic International Baccalaureate. The college plans a considerable expansion of its post-16 provision.

Building Construction Strategy

16. **The first phase** remodelling involved removal of all external timber cladding, felt roof and all the blockwork walls except the few bracing the concrete frame. The blockwork inner skin of the external wall provides insulation, while powder coated aluminium cladding panels with matching double glazed windows were used externally to provide an overall low maintenance finish. The existing 'Stramit' flat roof had insulation added over and was finished with high performance felt. The internal partitions are a mixture of metal stud with plasterboard, glazed panels and some self-finished demountable office partitioning systems. Ceilings are suspended demountable fibrous plaster in a majority of areas.

17. **The second phase** was of steel frame construction. Intermediate floors are of precast concrete planks and the pitched roof is finished with insulated profiled sheet steel. The external walls are blockwork inner skin with facing brickwork at ground floor and insulated steel sheet cladding at the first floor. Internal partitions are non-loadbearing blockwork or metal stud and plasterboard. Suspended ceilings are used throughout both phases; recessed light fittings with louvre baffles being a feature of the second phase.

18. **Services** to both phases are similar, both adopting gas fired boilers for water fed radiators. Some mechanical ventilation is used for toilets and kitchens, with tempered air to the drama studio. The building management system installed in both phases controls lighting, power and fire alarms as well as heating. The college has an extensive installation of three compartment plastic trunking to distribute power and various signal cables.

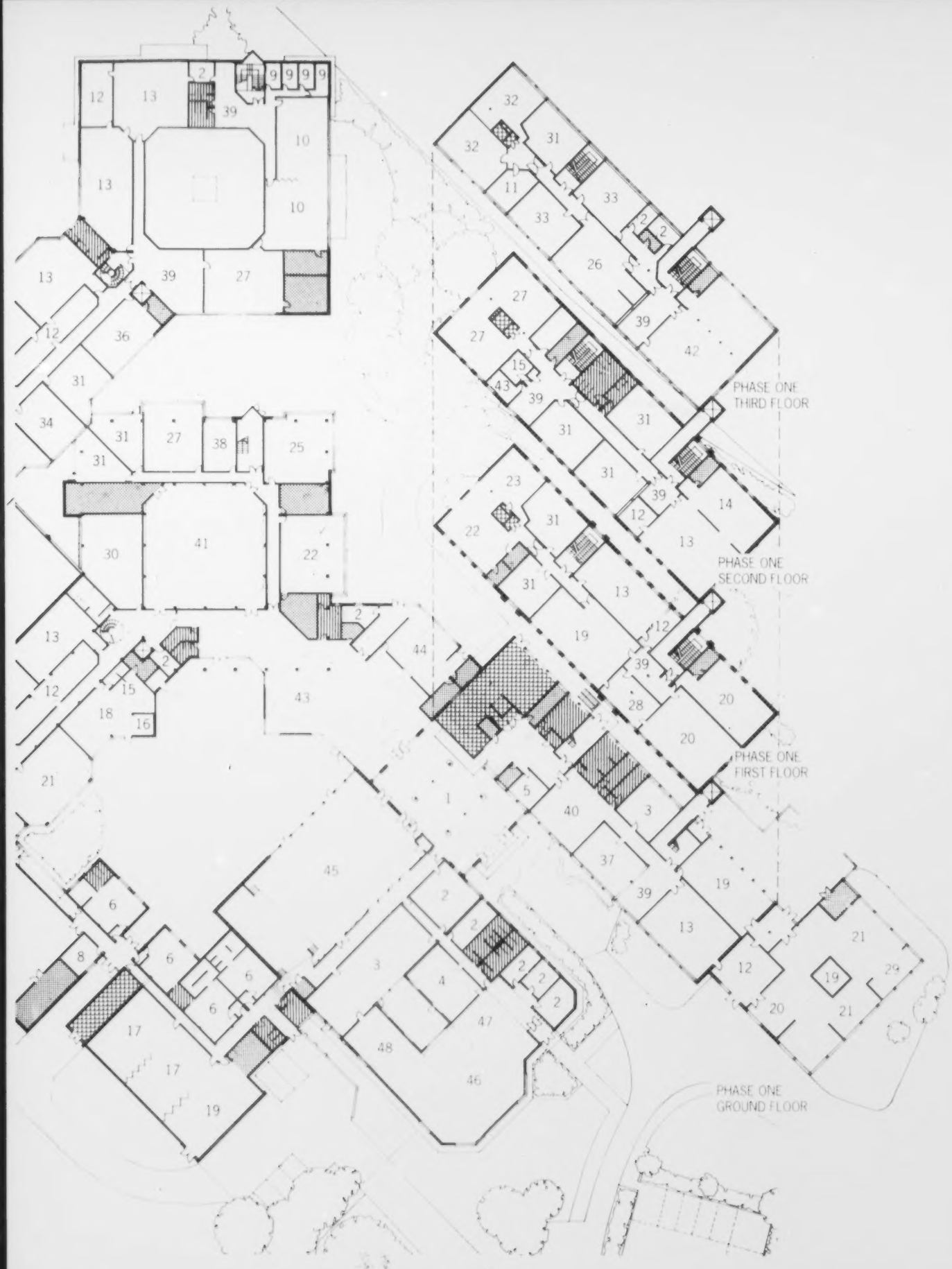
19. **Finishes** are generally of emulsion painted plaster to walls with some tiling in toilets and specialist areas. Woodwork internally is finished in brightly coloured stains. Wherever possible, floors are finished with carpet tiles in teaching and circulation areas. Heavy duty vinyl sheet is laid in science, food and other technology areas, with ceramic tiles in toilets and specialist rooms.

Fig. 6 Building plans

Key

1. Reception/ entrance hall
2. Office
3. Staff room
4. Principal/Board room
5. Medical inspection
6. Changing
7. Sports hall
8. Multi-gym
9. Music practice
10. Music
11. Sound studio
12. Science prep.
13. Science laboratory
14. Science projects
15. Darkroom
16. Kiln
17. Art *
18. Ceramics/pottery
19. Design/graphics *
20. Science/tech
21. Multi-materials workshop
22. Food
23. Dry/textiles
24. Wet textiles
25. Child-care
26. Info. technology
27. Business studies
28. Technology prep.
29. Heat bay
30. Robotics/ technology
31. General teaching
32. Mathematics
33. Languages
34. Language lab
35. N/A
36. Information processing
37. Inter-active video
38. Sixth form tutorial
39. Social/work area
40. Social
41. Drama studio
42. Drama/lecture/ team teaching
43. Dining
44. Kitchen
45. Assembly hall
46. Library/info centre
47. Librarian/reception
48. Reprographics

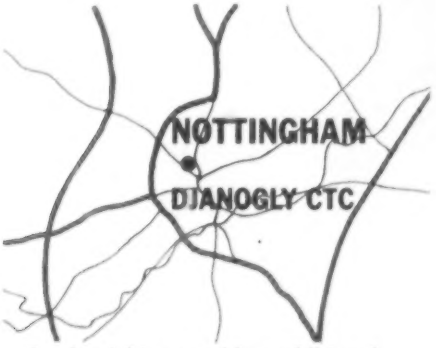
* Existing Gymnasium to be converted as numbers increase


PHASE ONE
THIRD FLOOR
PHASE ONE
SECOND FLOOR
PHASE ONE
FIRST FLOOR
PHASE ONE
GROUND FLOOR

DJANOGLY CTC
Nottingham

1. The site finally selected for this, the first newly built CTC, is the smallest at 4.5 acres. It is however typical of the urban locations considered appropriate for the programme and as such is in common with the experiences any LEA might have in providing a local neighbourhood school. The use of pavilions in the design also means that schools wishing to add an additional block to existing accommodation can benefit from the lessons learnt at Djanogly.

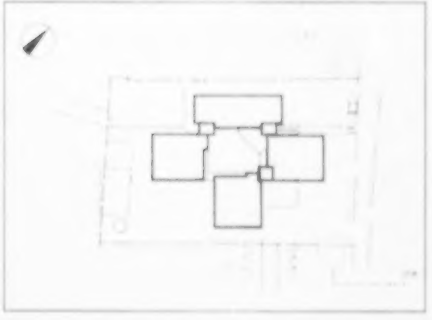
Fig. 7: Location Plan



2. Surrounded on three sides by Victorian terraced housing and light industry, the fourth side is bounded by the busy Nottingham Road leading from the city centre. The site had previously been occupied by a bonded warehouse belonging to Players. This, and a series of previous uses, left a site almost completely covered in reinforced concrete, large buried tanks and three levels of brick arched basements containing rusting machinery, all of which had to be removed or filled. The sandstone is typical of the area and required each excavation for foundations to be probed for possible caves. In spite of these unusual factors the abnormal costs on foundations were not excessive.

3. A & B Branch were pleased to be invited to be architects for this project. They were already advising the Department's CTC Unit on building and planning matters related to the whole CTC programme and this development project was an opportunity to experience first hand the complexities involved. It was also perceived as important that one of the earliest CTCs should act as a pilot project to the whole programme, and as the first new build Djanogly offered an excellent choice.

Fig. 8: Site Plan



CASE STUDY DATA-SHEET
DJANOGLY CTC, NOTTINGHAM

College Principal
Mr Matt Andrews
Project Director
Mr John Ramsden CBE
Main Contractor
Norwest Holst Management Contracting Ltd
Architect
DES A & B Branch
Services Consultant
E G Phillips
Structural engineers
Bunyan Meyer Associates
Quantity Surveyors
Gleeds
Furniture procurement
Yorkshire Purchasing Organisation

Type of Building	100% new build
Type of Contract	Management Contract
Total Capacity	1000 pupils
First year intake	167 pupils
expected Post-16 intake	165 pupils over 2 years
Area of site	1.8 ha
Area of existing building	none
TOTAL GROSS AREA	9278m²
	9.28m² per pupil
Total teaching area	5665m²
	61% of gross
TOTAL BUILDING COST	£ 5,660,136
	£ 619 per m²

Design Strategy

4. The constraints of time with this project and the need to proceed with detailed design briefing whilst the enclosure was being determined, led to an overall design solution of a series of interlocking repeated pavilions. These were designed with flexibility to accommodate a range of differing spaces in size, character and complexity of servicing. There are three pavilions of deep square plan, with rooms surrounding a central atrium space.

5. The atrium contains the central resource areas, lit from above, which can be simply divided by movable screens, demountable storerooms and darkrooms. The visual connection with

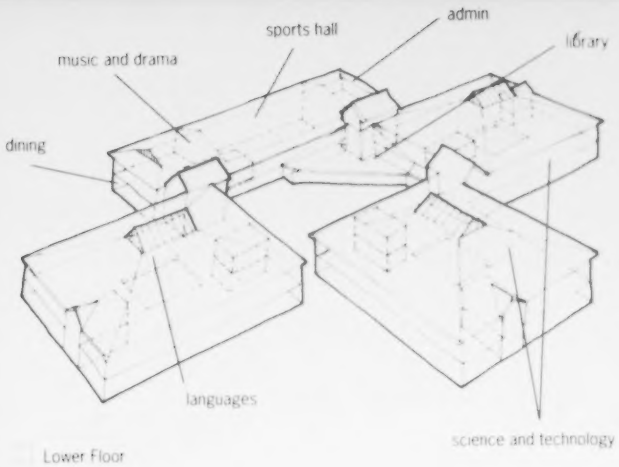


Fig. 9: Disposition of spaces

The central atrium of the enterprise pavilion; movable screens and demountable darkroom provide pin-up area and enclose the central Art space.

The pedestrian route to the main entrance is via a footbridge.

the first floor is made by the glazing onto circulation and small study spaces at this level.

6. A fourth pavilion of linear form contains administration and large, specialist spaces, such as drama and dance, music, sports and dining facilities.

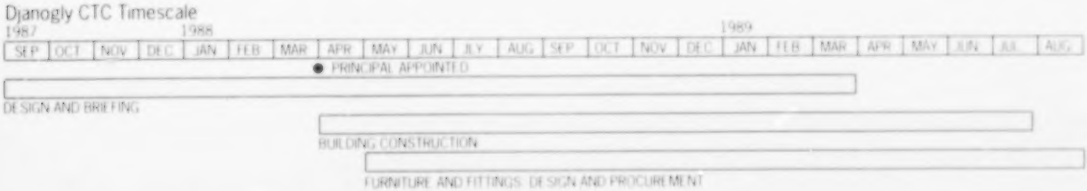
7. The library and resources centre links all these elements of the college. Its form within the central court emphasises the natural transition between the building and external spaces. The form and location of the buildings on the site has created a series of outside spaces; protected courtyards for sitting and for study, practical work areas, an environmental study area with a pond and two multi-purpose all-weather courts, all fulfilling the minimum statutory provision.

8. Pedestrian **entrance** to the college is via a footbridge from Sherwood Rise, over the road linking the car parks, to keep vehicular and foot traffic separated.

Organisation

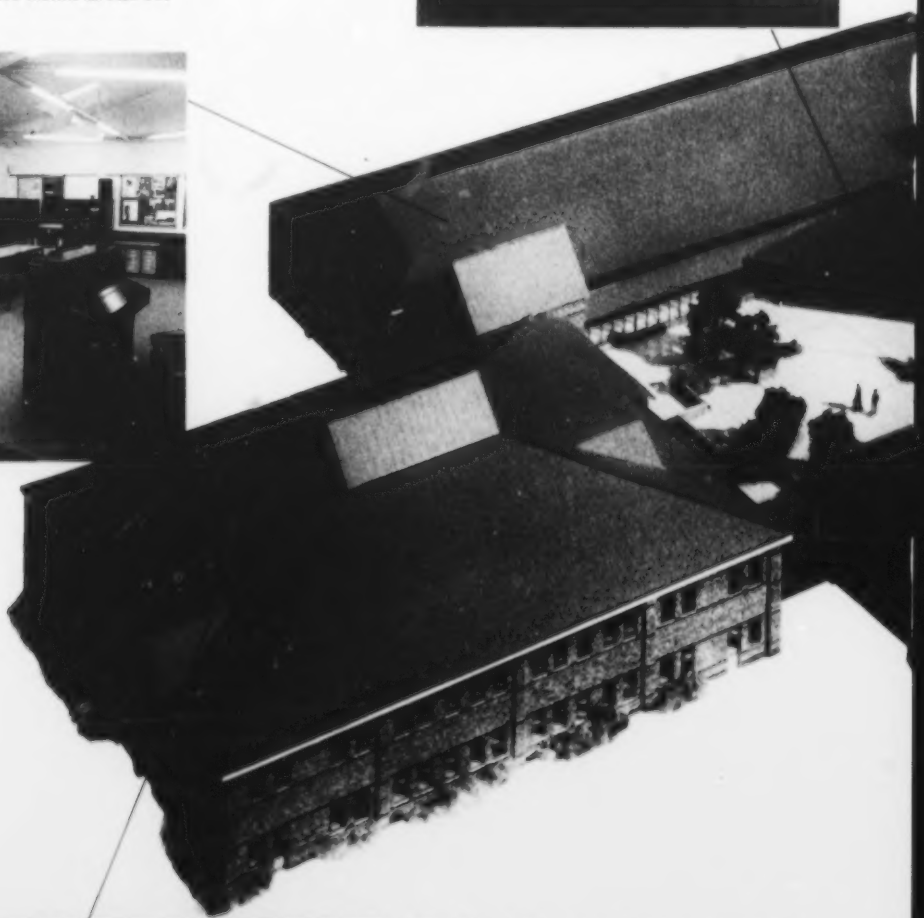
9. Four faculties, including "Expressive Arts", "Heritage and Communications", "Enterprise and Business Links" and

Djanogly CTC Timescale


1987
1988
1989
SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JLY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG
PRINCIPAL APPOINTED
DESIGN AND BRIEFING
BUILDING CONSTRUCTION
FURNITURE AND FITTINGS: DESIGN AND PROCUREMENT

The **library**, centrally placed adjacent to the quiet central courtyard, offers a fundamental role in serving the learning process. Computers, accessing information in CD-ROM, and video and audio based material, are available here and linked to every part of the college.

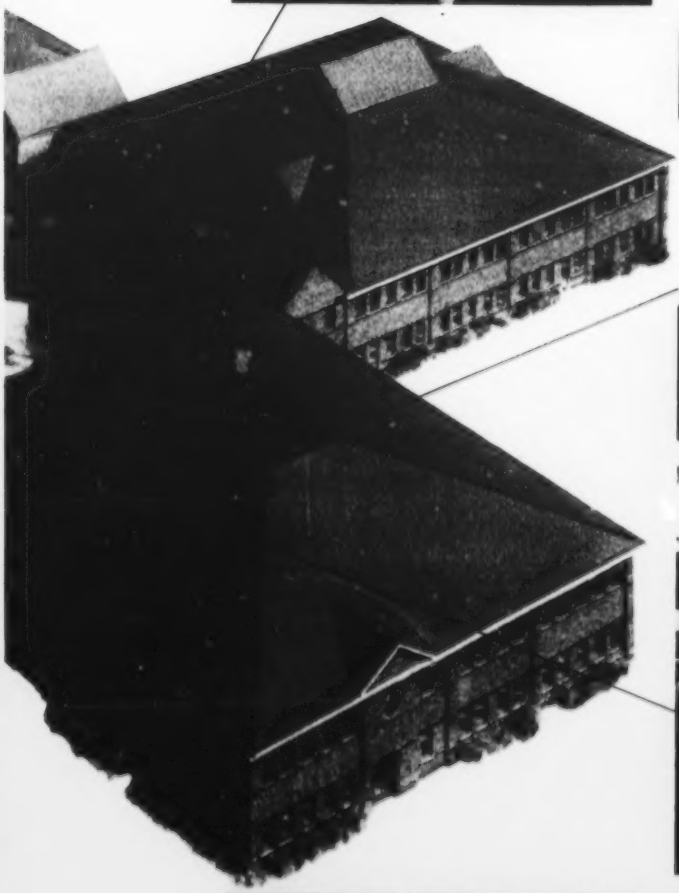
Expressive Arts, including Music, Dance, Drama and the main sports hall are accommodated in the specialist pavilion, with dining and administration. These also constitute the main areas for community use.



The **Heritage and Communications** pavilion houses an open atria used for assembly, surrounded by shared study areas on first floor. The large language centre pictured allows learning through computers, audio, video and world-wide satellite TV.

The Enterprise and Business Links pavilion centres on the Business Understanding Suite containing computers for large groups and 'model office' provision.

Science is mainly housed in the middle pavilion, with advanced laboratories in the adjacent block. All facilities are at first floor, serviced from below.



The atrium of the **Science, Mathematics and Technology** pavilion is used as a central design resource and lecture area. The mezzanine, containing computer resources, links Technology on the ground floor with Science above.

Design Technology spaces, around the central atrium, are open plan to allow woodwork, metalwork and plastics to be worked with together. Electronics, pneumatics and computer aided design are also catered for.

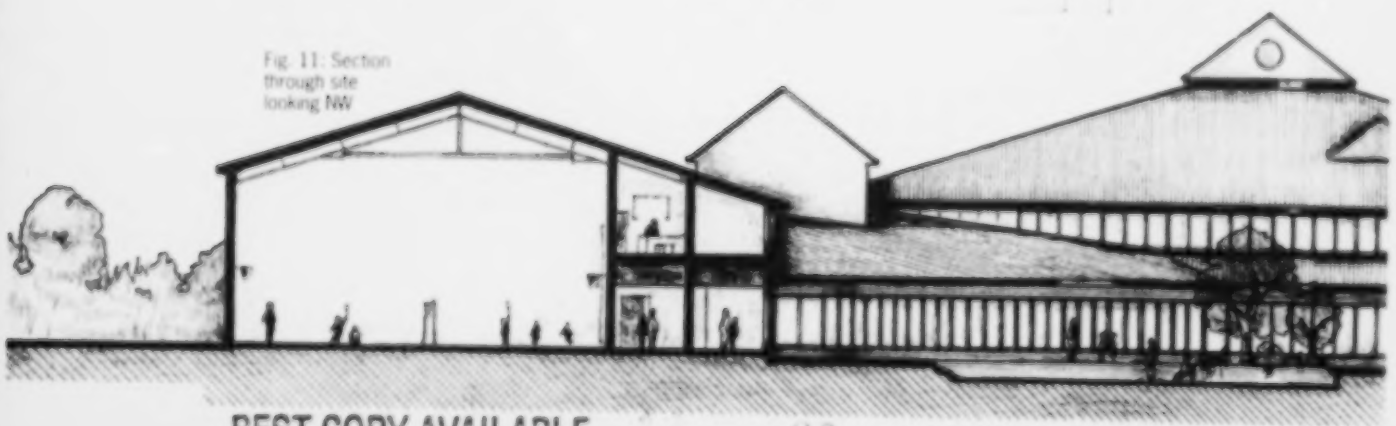
Fig. 10: Floor plans

Key

1. Reception
2. Office
3. Staff room
4. Board room
5. Medical inspection
6. Computer room
7. Changing
8. Sports hall/
9. Multi-gym
10. Music practice/ activities
11. Science projects
12. Science prep.
13. Science laboratory
14. Animals
15. Darkroom/ optics
16. Kiln
17. Art
18. Ceramics/ textiles
19. Design/ graphics
20. Design/ technology
21. Multi-materials
22. Food
23. Dry textiles
24. Wet textiles/art
25. Computer-aided design
26. Info. technology
27. Business understanding

Store
Toilets
Plant

Fig. 11: Section through site looking NW



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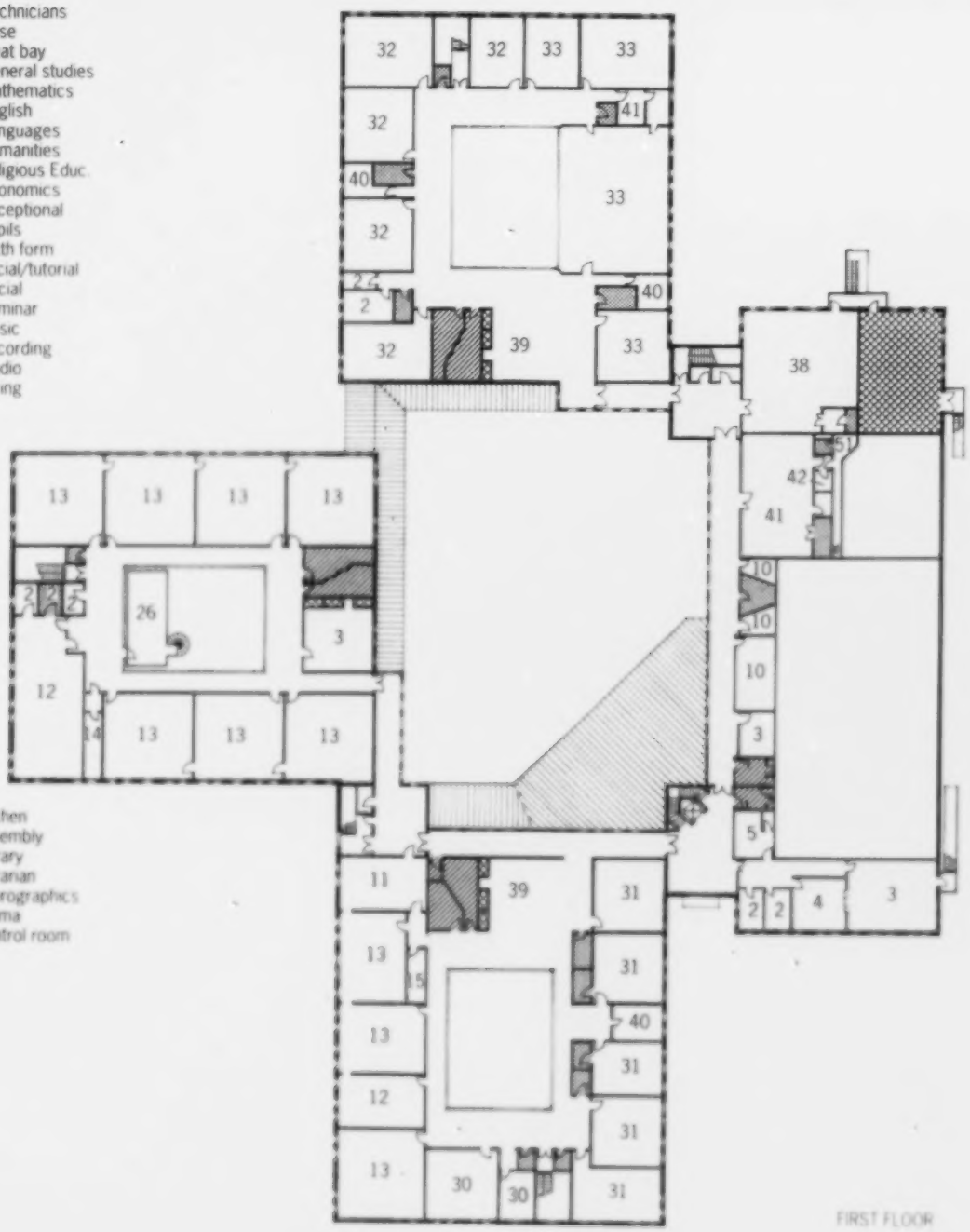
28. Technicians base
29. Heat bay
30. General studies
31. Mathematics
32. English
33. Languages
34. Humanities
35. Religious Educ.
36. Economics
37. Exceptional pupils
38. Sixth form social/tutorial
39. Social
40. Seminar
41. Music
42. Recording studio
43. Dining

44. Kitchen
45. Assembly
46. Library
47. Librarian
48. Reprographics
50. Drama
51. Control room



FIRST FLOOR

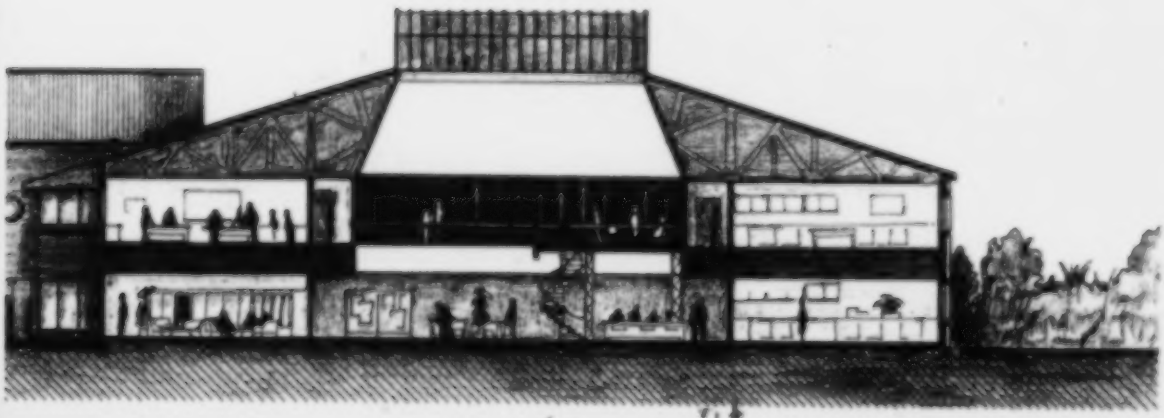


Fig. 12: First floor plan of Heritage and Communication pavilion, showing furniture layouts.

Key

1. Store
2. Language Centre
3. Languages
4. English
5. Seminar Room
6. Shared Group Learning Areas
7. HoD
8. Staff Room
9. Language Recording Studio
10. Satellite TV Receivers
11. Social Base
12. Toilets

A. 1200 x 600 Tables
B. Low Tables and Upholstered Chairs
C. Movable Screens and Lockers
D. Tutors Computer
E. Pupils Computer
F. Special design Desks with integral Tape Decks
G. Special design Tables with four Computers, TV or Video Screens and Keyboards
H. Control Desk

"Science, Mathematics and Technology" and each has a faculty director. Although the faculties broadly relate to the pavilions, the natural overflow of accommodation and the general application of prime facilities such as IT, technology, languages and communication, emphasise the strong cross-curricular links. In fact 'library and resources' forms almost a fifth faculty underlining its function of serving all the main faculties.

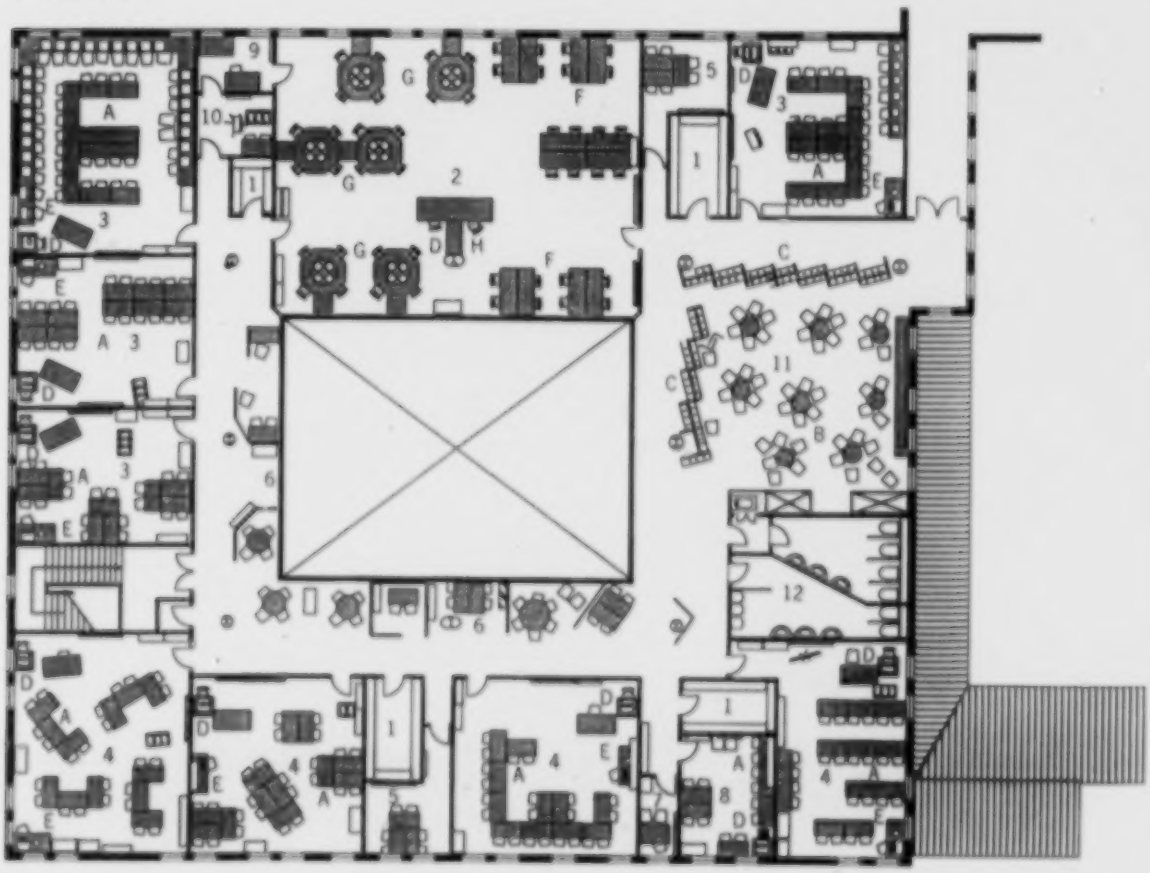
10. The **library** is used extensively for individual or group study and is popular with pupils. The college predicts pressure on this accommodation because of its use and the increasing concentration of computers in the library. Some decisions about extending the library, providing satellites for study and use of resources, or exploiting the IT network, have to be made by the college. **Reprographics** facilities behind the library control desk makes it usable by staff only, as planned. However the level of use has exceeded provision at Djanogly and areas of up to 90m^2 are recommended in current briefing advice to CTCs.

11. The college opened with a Principal and two Deputy Principals; one taking responsibility for curriculum, the other for finance, administration and personnel. The management team also includes the four faculty directors. **Support Staff** of technicians, librarian, systems manager and building and sites supervisors, operate across the whole college with every attempt made to blur distinctions of teaching and non-teaching responsibilities.

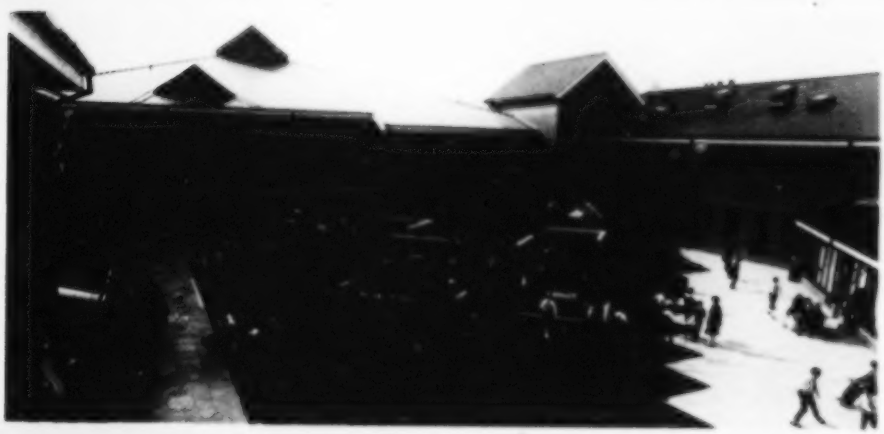
12. **Enrichment** activity takes place through co-ordinated activities during the day which starts at 8.30 am and often extends until 5.05pm.

Construction Strategy

13. The **structure** was repetitive for the three main pavilions, using a 9m grid of steel columns on concrete pad foundations. Stair and WC/service towers brace the frame in 3 pavilions, leaving internal partitions non-loadbearing, made of metal stud and plasterboard and potentially removable as they are located at their heads in a recess in the suspended ceiling grid. A metal deck topped with concrete forms intermediate floors and steel trusses the low pitched roofs of insulated metal sheet to all the pavilions. The different functions in Pavilion 4 suited a linear portal construction braced by blockwork



All pavilions centre around the courtyard, which links closely with the fully glazed library and contains greenhouses and a sculpture.



Environmental studies are fostered in the south corner of the site, where 'wild' vegetation surrounds a pond.

cross-walls giving good acoustic separation. The outer walls are all of timber framed inner skin with brickwork facing. The steel frame columns are clad in brick and expressed in the detailing. This sits on a continuous perimeter ground beam. Windows are hole-in-the-wall, hardwood vertical sliding sashes or top hung pivot, at centres which allow a high degree of flexibility of layout.

14. **Services** are relatively simple with gas fired boilers in a single plant room serving convection radiators around the perimeter of all buildings. The three deep plan pavilions remain naturally ventilated by stack effect from the central atria. Specialist and internal spaces to Pavilion 4 require air supply and extract. All principal services are on a ring main to the pavilions, allowing easy extension into pavilions as functions change over time. Horizontal distribution within ceiling voids affords flexibility of servicing into spaces below or, when required, through the floor to those above. Distribution of electrical and signal cable services within all areas is via an aluminium trunking by Rolfe King, running at dado level. A rectangular profile is generally used but a triangular profile in workshops and laboratories allows stool-height benching to be pushed against the perimeter.

15. **Finishes** to walls are generally emulsion paint on plasterboard or rendered surfaces with wallpapers used in some office areas and the boardroom. Oil based fleck paints are used in areas such as changing and toilets. Wall tiles protect critical areas and WCs utilise durable laminate finished ducting systems to provide an easy clean and colourful environment. A rail at dado level runs in most teaching spaces protecting walls or radiators from chairs, tables and people. In corridors this rail is often faced with laminate. This integration by the interior designers into an overall scheme includes all woodwork in brightly coloured stains to accentuate the grain and also to give each pavilion a different primary colour theme. Carpets, vinyl sheet, woodblock and woodstrip, ceramic tile and terrazzo tiling are used in appropriate spaces throughout this college.

MACMILLAN CTC
Teesside

1. Macmillan CTC is located on the edge of an industrial area of Middlesbrough. The industrial and technological scene that is encompassed in the view from the front entrance includes an industrial waste incinerator, a motorway fly-over, railway and regular aeroplanes over from nearby Teesside airport.

Fig. 13: Location Plan

2. This was once the site of the former St Michael's RC secondary school which closed in 1981. This flat roof steel framed single and three storey system building of the 1960s was substantially retained to form the new Macmillan CTC. However, the original workshop block was unsound and was therefore demolished. A two storey replacement to accommodate technology and science was constructed in its place. As such about 65% of the total accommodation is the result of remodelling or refurbishment and is typical of the experiences many LEAs are faced with in their secondary schools. Unfortunately the playing fields of the original school were not available when establishing this college. Although statutory hard play area can be achieved on-site, other arrangements have to be made for play pitches off-site.

Fig. 14: Site Plan

CASE STUDY DATA-SHEET
MACMILLAN CTC, TEESSIDE

College Principal
Mr John Paddick
Project Director
Mr T R C Wills
Main Contractor
Wimpey Construction (UK)
Architect
DEWJOC
Services Consultant
Hewertson Jenkinson Partnership
Structural engineers
Hutter Jennings & Tichmarsh
Quantity Surveyors
Turner Townsend
Furniture procurement
Yorkshire Purchasing Organisation

Type of Building	54% refurbishment
	46% new build
Type of Contract	Management Contract
Total Capacity	1050 pupils
First year intake	180 pupils
expected Post 16 intake	150 pupils over 2 years
Area of site	2.4 ha
Area of existing building	4353m²
TOTAL GROSS AREA	8099m²
	7.71m² per pupil
Total teaching area	4768m²
	59% of gross
TOTAL BUILDING COST	£ 3,755,110
	£ 650 per m² new build
	£ 365 per m² refurb

Design Strategy

3. The new image of the college is immediately evident from the glazed bridge link that provides an alternative circulation route at first floor level between each of the existing three storey buildings. This reduces traffic in the busy entrance foyer. The foyer is quite spacious with an exhibition bay and reception area leading to a general office at a lower level. The dining room opens off this area and already the popularity of college meals has put pressure on this provision. The overflow into the foyer space is unlikely to be sufficient and additional facilities may be necessary.

4. The information centre or library, created out of an existing courtyard roofed over with pyramidic skylights, is central to the college. Reprographics is not carried out in a substantial way anywhere in the college, as it was found that a private company could produce the work more economically. Beyond the library, the main hall and stage, music room and gymnasium are linked by a single storey wing containing general teaching and IT rooms. Assembly can be accommodated for 400 pupils in the hall but in some cases assemblies are carried out

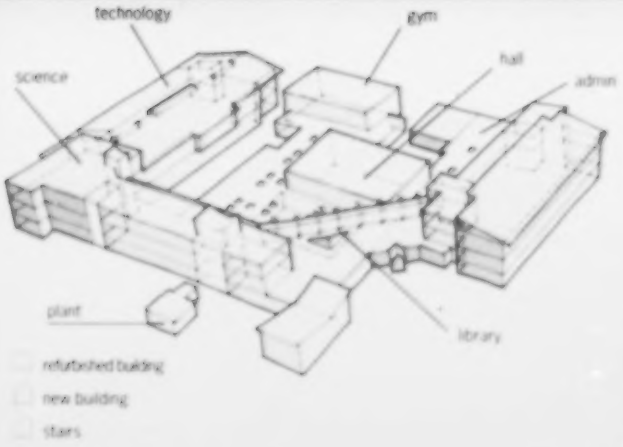


Fig. 15: Disposition of spaces and areas of new and refurbished building.

The south east wall of the new block curtain glazing beyond incorporates an overhanging extension which houses the shared work area in Technology at first floor.

The site is located on the edge of the industrial landscape of Middlesbrough.

through the tutor group system via the IT network. This college believes in transmitting all urgent information this way and is establishing TV monitors around the building for this purpose.

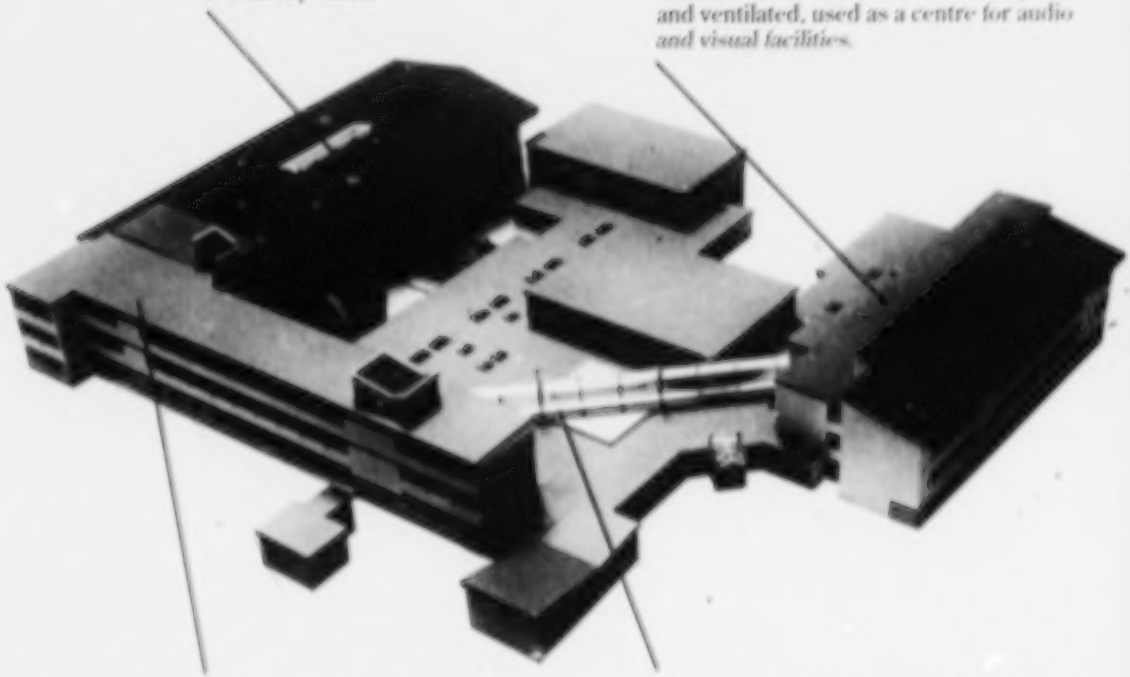
5. An existing three storey wing links the foyer with the new science and technology block. The ground floor houses general teaching rooms, while the first and second floors accommodate maths and science, with links through to more science laboratories in the new block. The science laboratories have been largely derived from existing accommodation. The number and range of sizes of science laboratories has not helped the operation of the college. A combination of subject dedicated laboratories and cellular rooms, some of which are only sufficient for half a group, will put pressure on their use in the future. The re-built block houses design and multi-materials workshops on the ground floor, linked by an open spiral staircase to Food, Textiles and Art spaces at first floor. Science and Technology are together on this level, helping to enhance their educational links.

6. The three storey block at the front of the college has been created from a wing of new building, nine metres wide, grafted onto the other side of a corridor that

Macmillan Americas

Technology is housed in the newly built two storey block.

The Business Understanding Suite includes an internal room, artificially lit and ventilated, used as a centre for audio and visual facilities.



A variety of existing **Science** laboratories are grouped adjacent to Technology. Service bollards allow island groups of work benches.

The **library** has been created by roofing the central courtyard with pyramidic skylights.

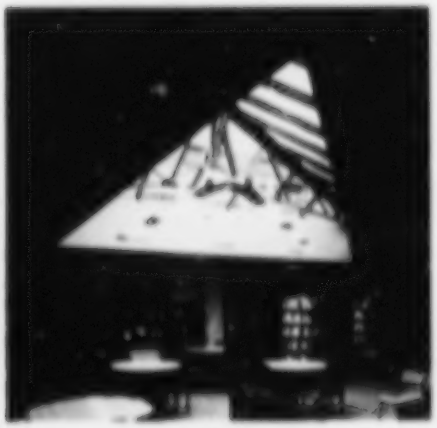


Fig. 16: Ground and first floor plans

Key

1. Reception
2. Office
3. Staff room
4. Meeting room
5. Medical inspect.
6. Exhibition area
7. Changing
8. Gymnasium
9. Music
10. Drama/stage
11. Assembly/ drama/dance
12. Science prep.
13. Science lab.
14. Shared resource area
15. Darkroom
16. Kiln
17. Art
18. Ceramics/ pottery
19. Design/ graphics
20. Design/Tech.
21. Multi-materials workshops
22. Food
23. Dry textiles
24. Wet textiles
25. Computer graphics
26. Info. technology
27. Business activities
28. Technicians base/materials
29. General teaching workshop
30. General studies
31. Mathematics
32. English
33. Modern languages
34. Humanities
35. Religious educ.
36. Economics
37. Exceptional pupils
38. Sixth form social/tutorial
39. Social tutorial
40. Lecture/board room
41. Careers/ personal development
42. Social/ tutorial/dining
43. Dining
44. Kitchen
45. Bins
46. Library
47. Librarian
48. Reprographics

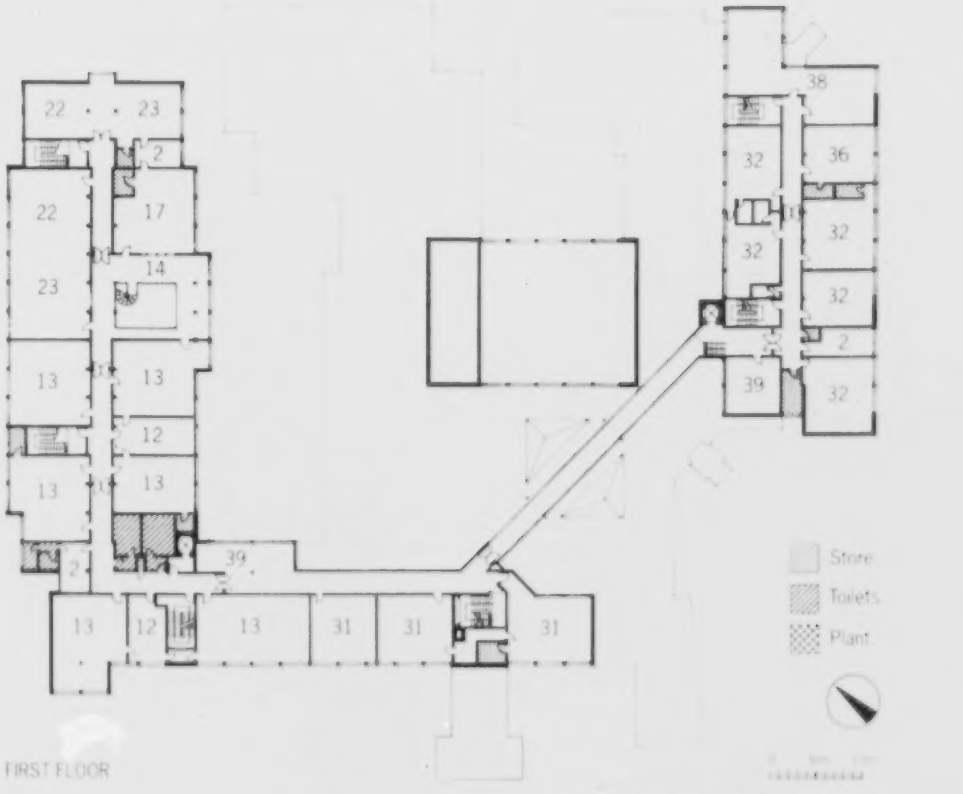


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Fig. 17: Second floor plans

Key to second floor

12. Science prep.
13. Science lab.
31. Mathematics
34. Humanities
35. Religious educ.
37. Exceptional pupils
38. Sixth form tutorial
39. Social/tutorial

SECOND FLOOR

originally served just a seven metre wide classroom block. Business studies, a boardroom and sixth form tutorial spaces are on the ground floor. A range of English and Humanities rooms are housed on first and second floors. As a legacy of the existing building, some ground floor offices are lit only by roof-lights and a business understanding room is artificially lit and ventilated. However, this is effectively used for audio-visual work.

7. The various buildings are all at differing levels, following the slight slope of the site. However, judicious use of coloured carpeted ramps and lifts allows full disabled access.

Organisation

8. **The management** of the college is subject based and not structured into faculties. The Principal has two deputy principals; one of these is the Director of Administration, the other is primarily responsible for the Personal Development Programme and IT. The management hierarchy then continues through a Director of Studies, Heads of Department and Heads of Year. This structure will develop as the third intake is accepted.

9. **Enrichment activity** is usually in the last hour or so of the day from 3.55 to 4.50 pm. Generally the buildings are open from 7am to 7pm, helping to serve the needs of the community, whilst the school day for main curriculum activity is from 8.30am to 5.00pm.

10. Some accommodation has been established for **small group study**, although the width of corridors has restricted opportunities to do this in the existing building. In two cases it has been possible to create small bays along single loaded corridors. There is a resource/shared area to first floor of the Science and Technology block but it has yet to be fully exploited.

Construction Strategy

11. The existing steel frame cladding was overclad to improve thermal performance. A powder coated metal sheeting was selected for recladding the existing blocks and this theme was extended to the new blocks to ensure a visual continuity. The flat roofs were stripped back, insulated and finished with high performance felts. Where possible suspended ceilings have been provided to run services out of sight and control acoustics.

12. **Services** on the mechanical side of the project were substantially retained and remain quite low-key. Replacement gas fired boilers in the existing boiler house supply perimeter radiators. Mechanical supply and extract air is provided for some internal spaces. Electrical services required major extension including the introduction of a dado level steel trunking system to most spaces for power, signal and IT services.

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BRADFORD CTC
Bradford

1. Bradford CTC is a newly-built college established on the site of Newby Square, formerly an area of old terrace housing and high rise flats in the heart of Bradford's urban development, south of the city centre. The site is on a substantial gradient, falling almost 20 metres from south to north. The site area is sufficient to have established adequate hard play areas, parking and planting around the college with a full size "all-weather" pitch reached via a "trim-track" to the top of the site.

Design Strategy

2. The design solution, developed by A & B Branch of the DES for planning approval, was an extension of the planning approach at Djanogly, but in response to site conditions, a series of pavilions or 'blocks' were established on terraces that climbed up the site. These pavilions are connected by a mall, which was developed by the project architects as fully covered, becoming the important social hub of the building.

3. This mall has a dramatic and unifying effect on the building with open balconies and the central 'amphitheatre' of steps and seats. It encompasses all

CASE STUDY DATA-SHEET
BRADFORD CTC

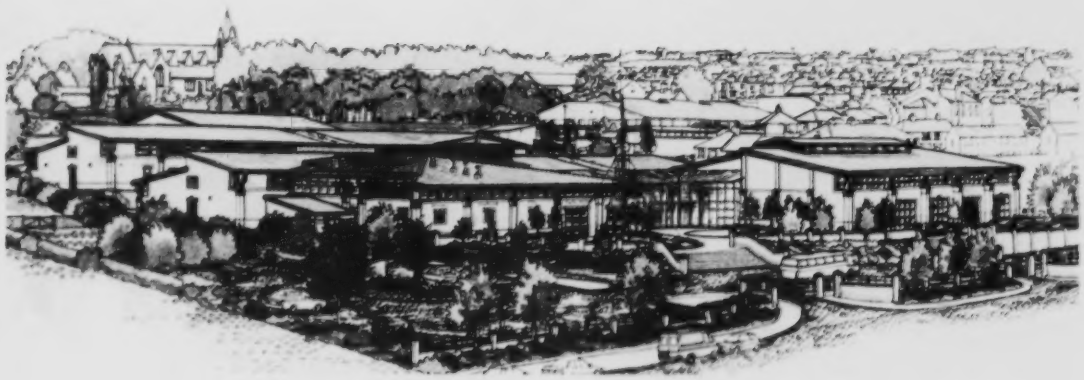
College Principal
Mr John Lewis
Project Director
Mr Tevor Williams MBE
Main Contractor
Miller Project Management
Architect
John Brunton Partnership with A & B Branch
Services Consultant
Brian Ford Partnership
Structural engineers
Arete Structural Consultants
Quantity Surveyors
Turner & Townsend
Furniture procurement
Yorkshire Purchasing Organisation

Type of Building	100% new build
Type of Contract	Management Contract
Total Capacity	980 pupils
First year intake	180 pupils (150 subsequently)
expected Post-16 intake	230 pupils over 2 years
Area of site	3.1 ha
Area of existing building	none
TOTAL GROSS AREA	9688m²
	9.89m² per pupil
Total teaching area	5281m²
	55% of gross
TOTAL BUILDING COST	£ 5,522,382
	£ 570 per m²

Fig. 18: Location Plan

Fig. 19: Site Plan

Artist's impression of the college in its urban setting, showing the front entrance.



The changing floor levels of the mall, as it follows the steep slope of the site, incorporates the central 'amphitheatre'.

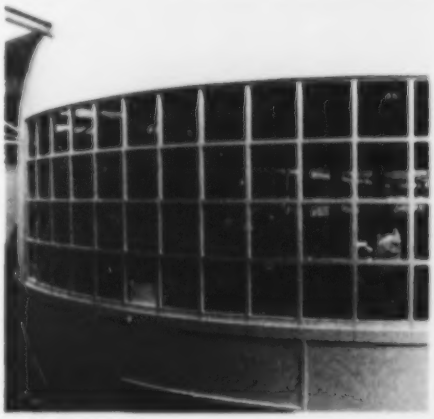
floor levels as it steps up the site. However, as the mall consumes considerable space, it is unfortunate that the activities of most blocks do not 'flow' naturally into the mall and potential for open social or resource areas is limited because of this.

4. Adjacent to the main entrance, the mall opens onto the 'pavement cafe' style restaurant area, with vending machines. Beyond this is the restaurant itself which links via a moving wall with the drama space. Open-plan administration offices are set between this and the library, which again opens onto the mall.

The curved glazed wall of the IT centre 'hangs' in the mall, above an open display/ lecture area.

5. A fully glazed IT room is strategically positioned at first floor level between the science block and the adjacent technology block. This was a deliberate attempt by the project team to form a key link between these two subject areas. It appears to hang in the mall, an effect emphasised by the large curved sliding doors to the lecture or exhibition space at ground floor.

6. A lift from the lower mall gives disabled access to the first floor accommodation of the four blocks, and further disabled access to the third level is provided by a chair lift. Both are key operated.

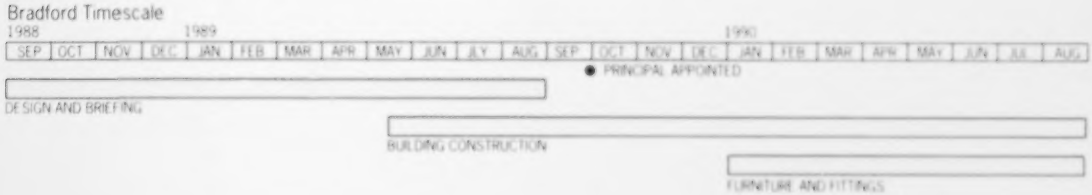


7. The four central teaching blocks are of 'CLASP'* construction, stepping up the hill. Each block is a mixture of two storey accommodation and double height spaces, usually open plan. This allows the upper floors to visually relate to the open plan areas using interior windows. Open balconies were not possible because of fire regulations.

The roofs of the CLASP blocks join to create the central mall, which continues on to link the sports hall block (left).

8. Accommodation for the sports hall and changing facilities is located in a block at the top of the site, near the all-weather pitches. An extra bay was added to the original sports hall design with sponsorship, and is large enough to assemble the whole school.

Bradford Timescale


1988
1989
1990
SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JLY AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG
PRINCIPAL APPOINTED
DESIGN AND BRIEFING
BUILDING CONSTRUCTION
FURNITURE AND FITTINGS

The 'pavement cafe' area, off the entrance of the central mall, links with drama and dining facilities.

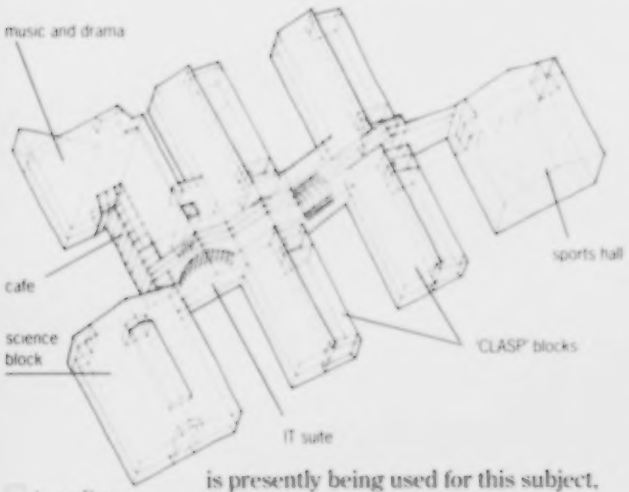
Organisation

9. The staff management structure adopted initially at Bradford is a direct response to the needs of the early years which will develop from this year's intake of 11 year olds. There are no post-16 students - indeed the college has chosen not to develop specific provision for this group initially but has plans for the future. The Principal has three Directors and a Head of Year forming his management team:

- a Director of Studies for curriculum development
- a Director of Student Services for liaison with other schools and with local business
- a Director of Financial Resources.

10. **Enrichment** activities will take place on two afternoons a week. They will be closely aligned with the college policy of **links with industry**. A specific business studies area will not be the ultimate provision at Bradford, as the College believes that business understanding should be delivered through the curriculum as a whole, and that pupils should understand the computer to be a tool rather than an experience for its own sake. However, the area above the library is presently being used for this subject, as the first year pupils currently do not have the necessary keyboard skills.

Fig. 20: Disposition of spaces.



11. **Assembly** for a year group is possible in the drama studio or the 'amphitheatre' in the central mall, and occasional large gatherings of up to 800 seated people can be held in the sports hall.

Construction Strategy

12. Once the basic cut-and-fill terracing had been completed the conditions were such that pressure grouting was necessary, in order to stabilise the ground sufficiently for a two storey construction. This was carried directly on a combination of rafts and strip footings. All seven blocks were of frame construction, four being lightweight steel from the CLASP* system, the others were insitu concrete, or traditional steel frame. The advantages of speed of construction and economy coming from the system steel frames have to be weighed against their limitations, due to cross-bracing, in creating open plan areas, and minimal loading capacity of upper floors. The fall of the site was exploited with the block at the front of the site where an accessible void was created to facilitate services to laboratories.

13. **External walls** are of cavity brickwork and insulating blockwork construction, the CLASP blocks being stud-lined. Most glazing is continuous strip curtain walling in powder coated aluminium. There is high level clerestory lighting between the mono-pitch ridges of each slope of roof formed from insulated profiled sheet steel. Partitions are of self finished metal framed studwork with stained hardwood door sets.

14. **Services** utilise local plant rooms to each block for serving hot water to perimeter radiators. Ventilation is generally natural with some mechanical supply and extract to critical areas. A steel, three compartment trunking was fitted in the contract, incorporating electrical distribution. It takes various signal cables, telephones and IT networking to all spaces.

15. **The finishes** were co-ordinated by the architect's own interior designers. A quality is derived from the use of timber, where possible, stained to express the grain, and a mixture of timber strip and large ceramic tiles to the floors in the mall. Carpeting is used extensively in the blocks, with vinyl sheet and ceramic tiles in specialist areas.

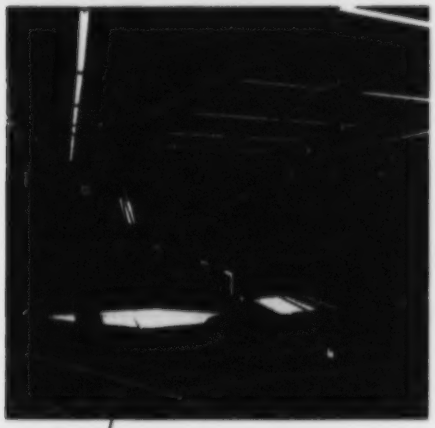
*Consortium of Local Authorities Special Programme, lightweight building system

The sports hall and changing rooms are adjacent to the all-weather games pitch at the top of the site.

General teaching rooms include a language centre with audio equipment in desks with cable management.

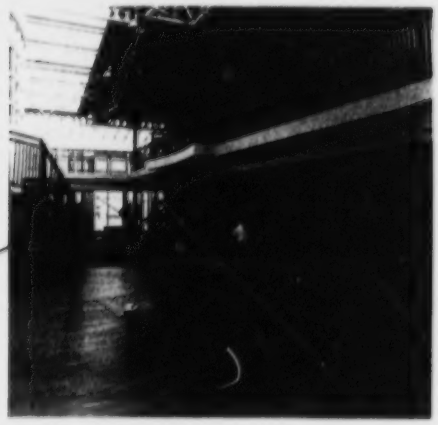
The library uses most of the ground floor of one block to provide a variety of learning resources.

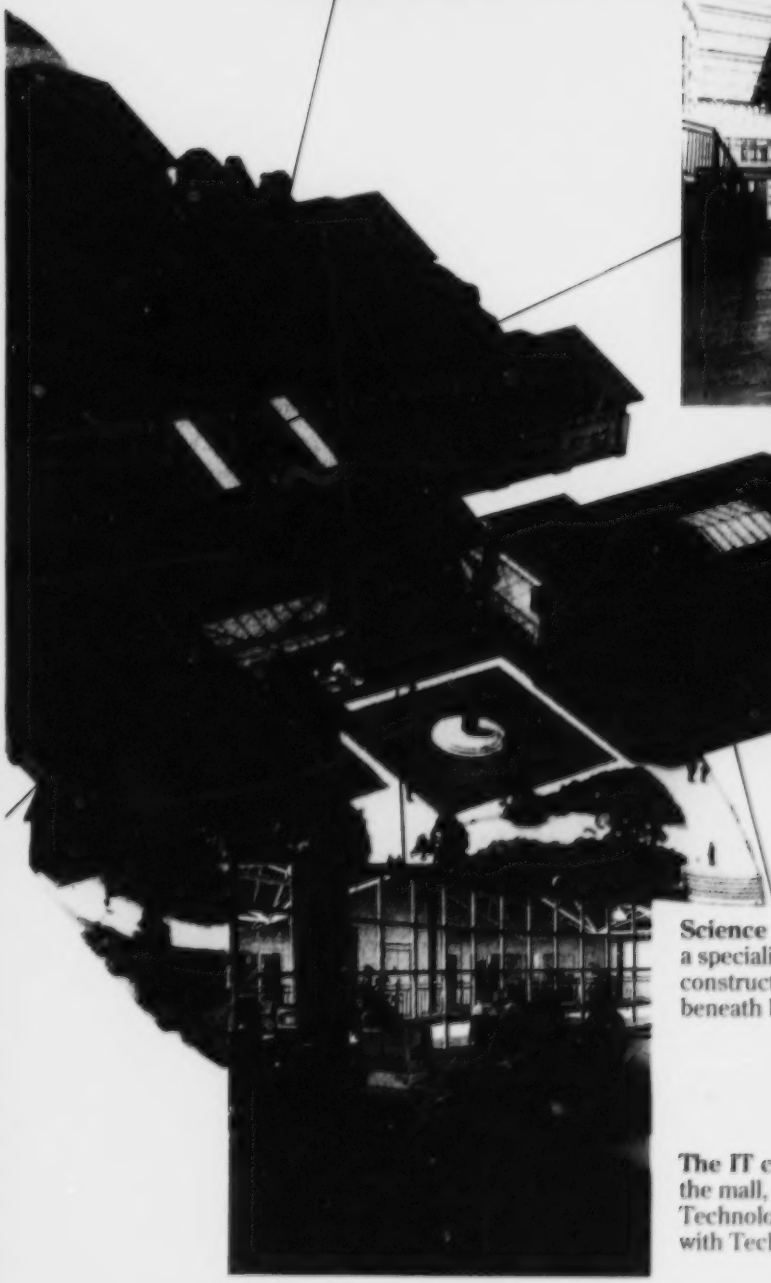
The dining area overlooks the entrance court and opens, via moving walls, onto the adjacent drama space.



Technology accommodation includes a double-height, open plan art and pottery area.

The central mall links the seven blocks with balconies and stairs overlooking social seating areas.





Science laboratories are all contained in a specialist block, using a concrete construction to create a service void beneath both floors.

The IT centre, with glazing overlooking the mall, offers a central Information Technology resource that links Science with Technology.

Fig. 21: Floor plans

Key

1. Reception
2. Office
3. Staff room
4. Board room
5. Interview room
6. Medical inspection
7. Principal
8. Changing
9. Sports hall
10. Activities gallery
11. Computer room
12. Science prep.
13. Science laboratory
14. Demonstration/ projects
15. Darkroom
16. Kiln
17. Art
18. Ceramics/ pottery
19. Design
20. Technology
21. Multi-materials workshop
22. Food
23. Art/textiles
24. Advanced tech.
25. Heat bay
26. Info. technology
27. Business understanding

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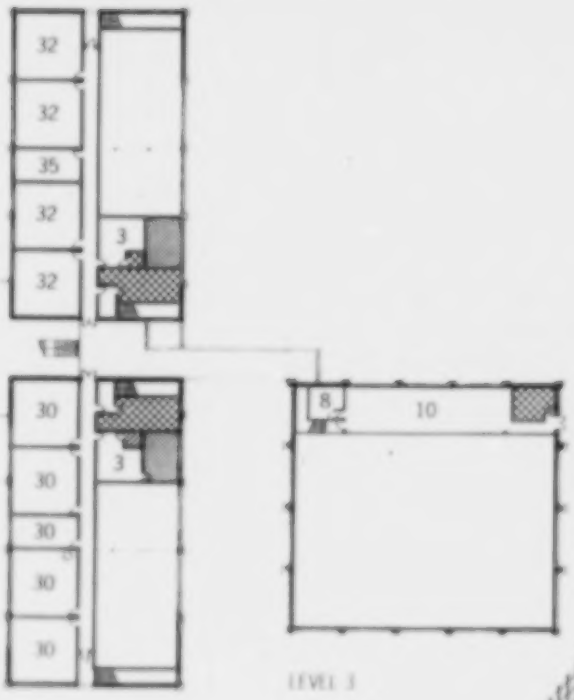
Fig.22: Section through central mall

28. Technicians base/materials
29. Projects
30. General teaching (presently rented out)
31. Mathematics
32. English
33. Languages
34. Humanities
35. Seminar
36. Open plan study area
37. Lecture/social
38. Exhibition/ lecture
39. Music
40. Drama studio
41. Drama Control
42. Cafe conservatory
43. Dining
44. Kitchen
45. Bins
46. Library
47. Library entry
48. Resources
49. Reprographics
50. Central Mall



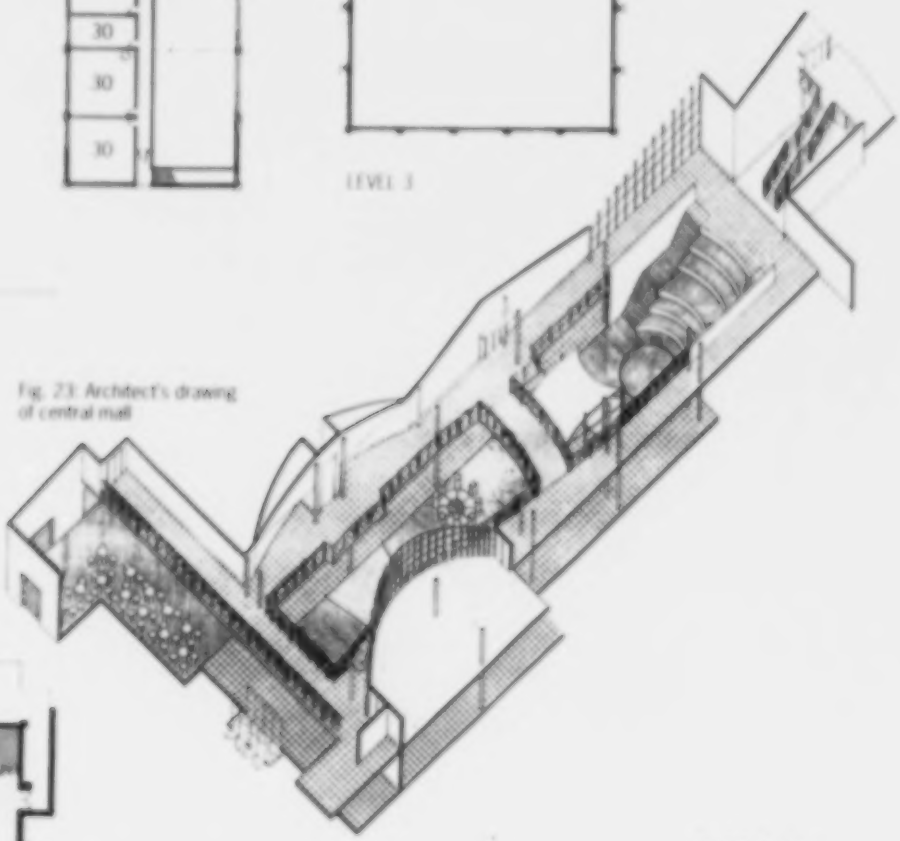


Fig. 23: Architect's drawing of central mall

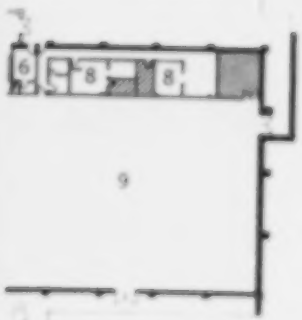


Fig.24: Section through 'Clasp' block, showing two storey side overlooking double height space.

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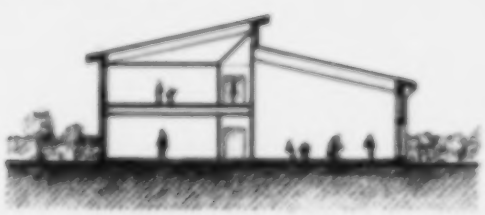
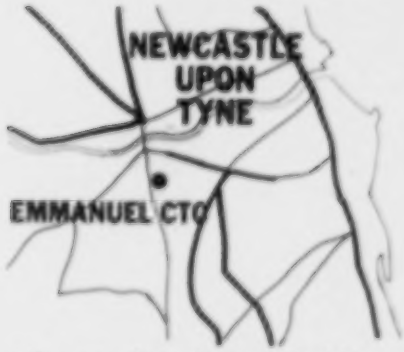


EMMANUEL CTC
Tyneside

1. Emmanuel College is a complete newly built CTC, which opened in 1990. It is situated in Consett Road, in the Lobley Hill area of Gateshead, about 2½ miles south west of the town centre and 3½ miles from Newcastle. The site is on the edge of the urban development and the catchment area for the college has a high level of unemployment. The new

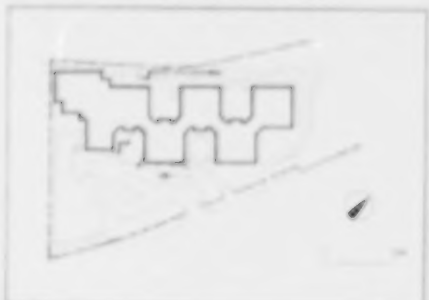
Fig. 25: Location Plan



college stands on the ground of the former St John Fisher Comprehensive school. The original CLASP* buildings, built in 1963, were demolished due to their poor condition. The site is gently sloping from north-east to south-west and the original school had followed this gradient by stepping down along what is a long and narrow strip of land sandwiched between the main road and a railway embankment. Strong educational and building economy advantages coupled with better disabled access results from each floor being on a single level but required considerable site excavation at the northern end.

2. The college was built in construction sequence in a linear pattern, allowing it to open and run without hindrance for two months while the construction of the last two blocks was completed. This was particularly important as Emmanuel had the fastest construction programme of all the CTCs, at fifteen months.

Fig. 26: Site Plan



*Consortium of Local Authorities Special Programme, lightweight building system.

CASE STUDY DATA-SHEET
EMMANUEL CTC, TYNESIDE

College Principal
Mr George McHugh
Project Director
Mr David Vardy
Client's Consultant
Howarth Litchfield Partnership/RNJ Partnership
Main Contractor
John Laing Construction Ltd
Architect
DEWJOC
Services Consultant
Cairns & Byles
Structural engineers
Hufters Jennings & Tichmarsh
Furniture procurement
Yorkshire Purchasing Organisation

Type of Building	100% new build
Type of Contract	Design and Build Contract
Total Capacity	900 pupils
First year intake	150 pupils
expected Post-16 intake	150 pupils over 2 years
Area of site	2.9 ha
Area of existing building	none
TOTAL GROSS AREA	9450m²
	10.50m² per pupil
Total teaching area	5317m²
	56% of gross
TOTAL BUILDING COST	£ 5,386,130
	£ 567 per m²

The atrium of the central pavilion contains the main staircase and reception area.

Design Strategy

3. The design solution is, like Djanogly and Bradford, based on a 'necklace' of repeated pavilions. This approach allows considerable economy by repetition of detailing, design and construction, particularly as the blocks are all linked in the same way. The five standard pavilions are similar to those at Djanogly, but smaller, each with 800 square metres on two floors. The atria areas, being half that of Djanogly, do not require the subdivision by a fire screen at first floor, ensuring a strong link

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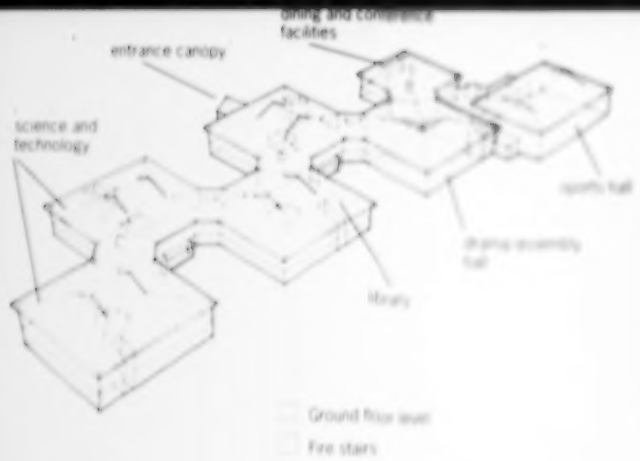


Fig. 27: Disposition of spaces.

The main entrance is highlighted by a glazed canopy.

between the two levels. However, screens will be necessary to ensure that the shared work areas planned for the first floor balconies are enclosed enough for study, while still being linked to adjacent classes and the atrium resource area below.

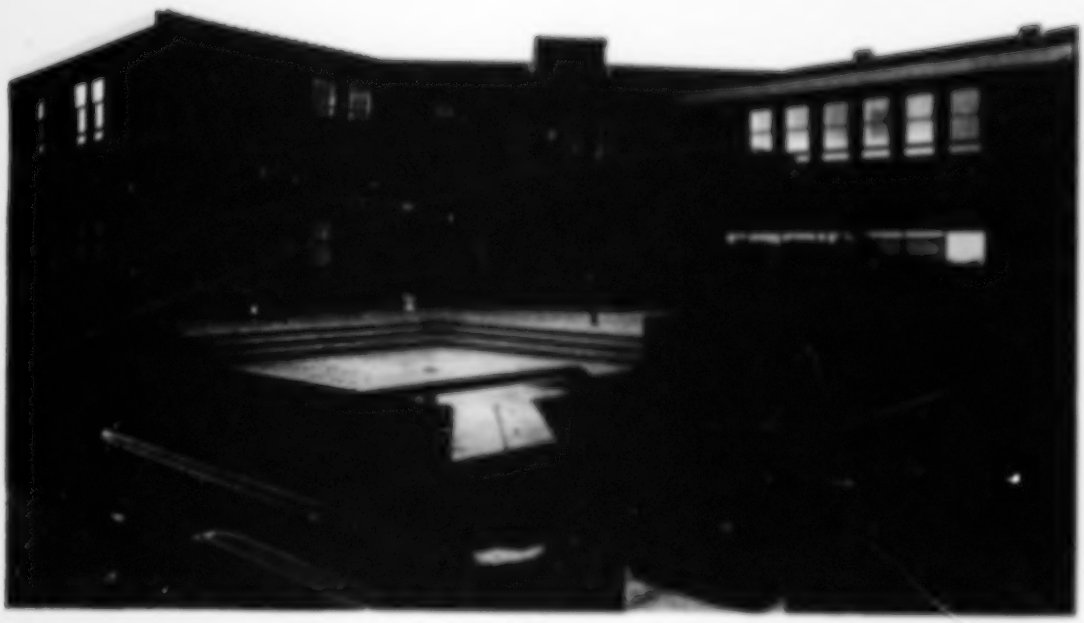
4. To the south, two specialist blocks of similar character accommodate dining facilities as well as the sports hall and changing area. A suite of conference and syndicate rooms with restaurant and exhibition area at first floor provides a focus for the activities of the Centre for Industrial Studies. These facilities are designed to draw in local business and industry representatives on a commercial basis but also to give access for students, establishing links which should develop over time.

Exhibition and tutorial spaces are created off corridors by glazed extensions.

5. The first of the standard pavilions contains the main double height assembly and drama hall. The remaining four house teaching rooms around central atria. These are lit from above and ventilated by 'stack' effect.

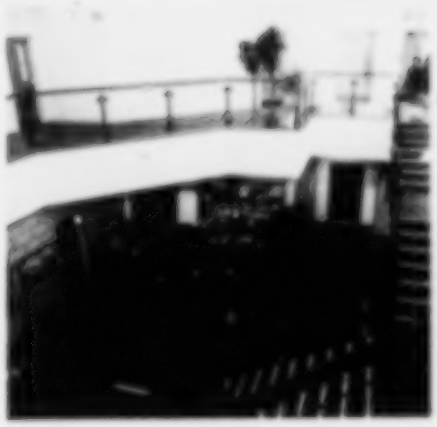
6. The atrium in the central pavilion has an open staircase below which is the main reception area, with the library

Emmanuel Timescale
1989

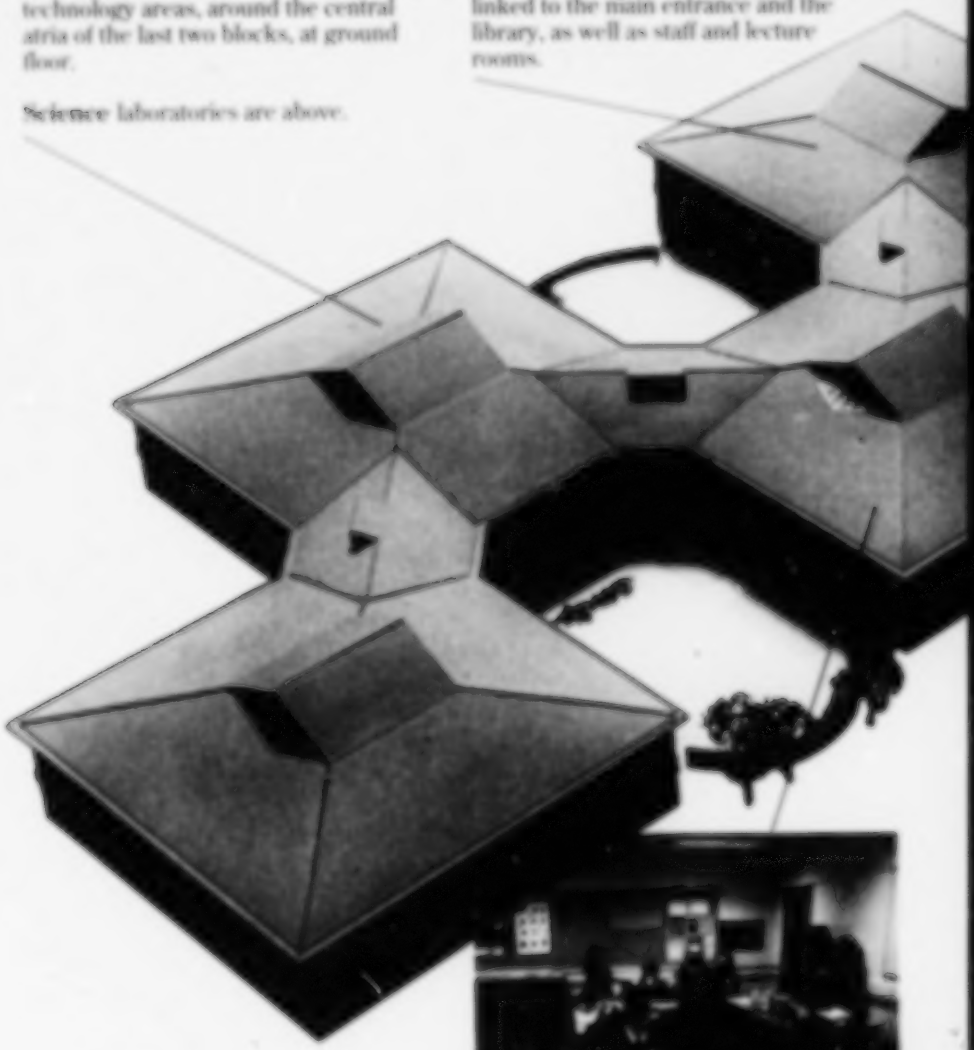


Art rooms are linked with other design technology areas, around the central atria of the last two blocks, at ground floor.

Science laboratories are above.



Reception, in the central atrium, is linked to the main entrance and the library, as well as staff and lecture rooms.



General teaching spaces are grouped around pavilion atria, particularly at first floor. Internal windows allow visual links to corridors and natural supervision.

The smallest pavilion houses the food hall and **dining** room, with the Centre for Industrial Studies above.

The *Library* is incorporated in two pavilions and is thereby adjacent to reception, whilst also opening onto an atrium adjacent to general teaching and business studies, as well as an external courtyard.

Single-storey changing rooms and stores link the **sports hall** block with the pavilion containing the ***assembly and drama hall***, other PE rooms and music.

Fig. 28: Floor plans.

Key

1. Reception
2. Office
3. Staff room
4. Meeting room
5. Medical inspect.
6. Principal
7. Music practice
8. Changing
9. Sports hall
10. Multi-gym
11. Dance/ Aerobics
12. Science prep.
13. Science lab.
14. Workroom
15. Darkroom
16. Kiln
17. Art
18. Ceramics/ pottery
19. Design
20. Technology
21. Multi-materials workshop
22. Food
23. Art/textiles
24. Computer room
25. Heat bay
26. Info. technology
27. Business studies
28. Technicians base/materials
29. Tutorial room
30. Shared work area
31. Mathematics
32. English
33. Modern languages
34. Humanities
35. Religious educ.
36. Sixth form study/social
37. Lecture room
38. Recording studio
39. Music
40. Assembly/ drama hall
41. Control room
42. Food hall (servery)
43. Dining
44. Kitchen
45. Wash up
46. Library
47. Exhibition/ tutorial
48. Reprographics
49. Enhanced studies
50. Coffee/ exhibition
51. Conference room
52. Syndicate room

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adjacent. The main entrance is signified by a canopy on the external facade.

7. The last two pavilions house multi–materials spaces, technology and a design studio, grouped around the central area. Science laboratories are on the first floor of these two pavilions, together with food and fabric studies and preparation rooms.

8. A series of staff rooms and offices are located within and between pavilions at each level. The characteristics of the planning provide these rooms with natural light and reasonable views into the courtyards, while still being close to the central spine circulation, allowing natural supervision of activities in the pavilions.

Organisation

9. The faculty structure at Emmanuel is being developed while staff and pupil numbers are still low, but the Principal indicated that the number of faculties would be kept to a minimum. In his view this approach is a true reflection of the emphasis made by the college on development of cross-curricular themes and activities. This philosophy has generated the layout of the building and the use of space. Great emphasis is placed upon easy, flowing access between related subject areas (for example art, design and technology). It is a natural progression that avoids the need for large faculty structures while encouraging wider staff responsibilities and their cooperation between subject areas.

10. The form of assembly for the pupils and staff is particularly important at this college. The Principal acknowledges that for the infrequent event of full college assembly the sports hall is adequate. However, for the regular assemblies of half the college, the multi-purpose assembly and drama space is most suitable. When numbers are up to capacity, the preference will be for first to third and fourth to sixth year assemblies.

11. **Enrichment** activity is integrated within the more traditional length of school working day which is regularly 8.30am to 3.45pm at Emmanuel College. All pupils are not expected to leave the building for breaks but are encouraged to develop their interests as part of the enrichment programme, with a full and free use of the college resources. This is wholly consistent with the philosophy developed with the planning of the buildings; a series of open and enclosed spaces generated in each pavilion from

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Students are encouraged to use the library facilities for enrichment activities.

central resource areas surrounded by teaching spaces easily accessible and linked by generous corridors containing bays and potential study areas. The disposition of staff accommodation and a level of involvement of teachers in these activities ensures a level of supervision which is intended to convey a sense of personal responsibility to each pupil.

Construction Strategy

12. As for Djanogly college, the **structural** repetition adopted for at least four of the pavilions greatly assisted the 'fast-track' building programme. All the pavilions are of steel frame construction on a 9m by 4.5m grid which sits on reinforced concrete pads. These pads and the concrete strip footings supporting the perimeter brick and blockwork walls are laid on ground that was stabilised through vibro-compaction due to the former colliery workings below the site. The intermediate floors are pre-cast concrete slabs with a lightweight trussed roof pitched and hipped to about 20°.

Two-tone blockwork banding in circulation areas, used with varnished hardwood door sets and coloured ironmongery, give a rich textured interior design.

13. Hole-in-the-wall vertical sliding windows of powder coated aluminium are incorporated to give a rhythm to the external elevation and a range of space sizes internally that are generally comfortably lit with pleasantly proportioned views out. The roof has been finished with interlocking concrete tiles and eaves are generous to help protect the walls and give strong modelling to the pavilions. The lighting to the central atria is through openable vertical triangles of glazing that are formed by truncating two opposite pitches of each pavilion roof. Internal sub-division in the pavilions is chiefly plaster-board on metal studs. A quality fair-faced blockwork in two colour bands is used at ground and first floor to delineate both sides of the wide circulation route winding along between all the pavilions.

14. **Services** are kept as simple as possible, with low temperature hot water radiators supplied generally by gas-fired boiler rooms individual to each pavilion. This minimises service-runs and enables almost domestic scale boiler rooms to give individual pavilion control or, indeed, isolation. Some mechanical supply and extract is provided to toilets, kitchens and other specialist areas. Those rooms not achieving the full provision of external opening windows have additional mechanical supply of air, which is extracted naturally by stack-effect through the atria. A steel trunking system at dado level was installed in the main building contract and fitted with power cables. A later contract was let for signal cables, these are also incorporated in this trunking as future extensions and modifications are easily facilitated.

15. **Finishes** to walls are generally painted plaster or plasterboard, or fair faced blockwork to external and internal walls with hardwood door sets, clear varnished to accentuate the texture of the grain. With the two-tone blockwork banding and subtle use of pavilion dedicated ironmongery colours, the interior design is one of modest and calm use of colour and richness of natural building material textures. Mineral board acoustic suspended ceilings are used in most areas with lighting recessed and baffled to reduce spectral reflection off VDU screens. Floor finishes are generally carpeting throughout teaching and circulation spaces, with vinyl sheeting in specialist spaces and ceramic tiles in showers and toilets. Semi-sprung 'Granwood' has been used throughout the sports hall, multi-purpose assembly and drama hall and the dance/aerobic area.

LEIGH CTC
Dartford

1. Leigh College at Dartford has been created from the Downs School, a comprehensive school built mainly in the '60's and '70's, with a capacity of 1500 pupils. This project is very relevant to any education authority with a secondary school contemplating major works. The buildings are on a split site, either side of Green Street, linked by a pedestrian bridge. Early studies considered the option of using only one site with a building proposal for a mixture of new construction and remodelling, possibly financed from capital receipts of the second site.

CASE STUDY DATA-SHEET
LEIGH CTC, DARTFORD

College Principal
Ms Virginia Waterhouse
Project Director
Mr R C Blackledge
Main Contractor
Crispin & Borst Ltd
Architect
Phippen Randall & Parkes
Services Consultant
Zisman Bowyer & Partners
Structural engineer
Austin Truman Associates
Quantity Surveyors
James Nisbet & Partners
Furniture procurement
Kent and Essex County Councils

Type of Building	96% refurbishment, 4% new build
Type of Contract	Schedule of Rates Contract
Total Capacity	1250 pupils
First year intake	210 pupils
expected Post 16 intake	200 pupils over 2 years
Area of site	5.3 ha
Area of existing building	14470m²
TOTAL GROSS AREA	12980m²
	10.38m² per pupil
Total teaching area	6640m²
	51% of gross
TOTAL BUILDING COST	£ 3,093,448
	£ 354 per m²

Fig. 29: Location Plan

Fig. 30: Site Plan

Ultimately the decision was taken to retain both sites to encourage community use, with the lower school on one site and upper school on the other.

Design Strategy

2. An analysis was made of existing accommodation, especially with respect to the large and specialist spaces and the likelihood that the CTC staying-on rate would lead to a very considerable growth in the numbers of post-16

The entrances to both the east and the west campus are enhanced by the 'hi-tech' addition of a new canopy.

The lower and upper school sites are split by a busy road, but linked with a footbridge.

The International Centre, containing computers and audiovisual equipment (serviced from underfloor wiring), can be let out for business use.

Additions to the mainly refurbished 1960's buildings include a new fire stair.

Leigh Timescale

students. This resulted in a decision to create a 1250 place CTC.

3. Leigh College had to be converted whilst the original school was still operating; a difficult but not uncommon experience. This was exacerbated by the work being almost totally refurbishment. The project had to be carefully planned, as teaching areas had to be decanted into the existing buildings which involved considerable temporary works. The ultimate decision to divide the college into a lower and upper school will minimise the amount of time staff are in transit from one site to the other but has resulted in many facilities having to be replicated on both sites. This affects the technician and resources support required and results in some duplication of equipment.

4. The core of the existing buildings were of 'finger' plan, typical of the period, and both sides of the split site have a variety of building heights. The lower school site is predominantly of one and two storey flat roof buildings, with the main part of the upper school being a flat roof three storey block .

5. Those briefing for and designing Leigh College have been conscious of the limitations that split sites, and separate two and more storey buildings can impose an access for the disabled. It has not been possible to provide lifts in addition to those two existing but a careful mix of accommodation has meant that access is possible to most curriculum areas.

6. Both the upper and lower schools have prominent entrances. The attractive and welcoming main entrance lobby at the lower school links through to reception and the administration suite beyond. It also forms the lobby for the impressive

Generally, rooms have been re-equipped with 'top track' used to hang pin board and shelves, with trunking below

Design Technology areas have specialist furniture

International Centre created from the library of the original Downs School. This includes a sophisticated facility for languages, satellite TV, video and information technology. This is equipped with the latest technology, utilising raised floors to accommodate the large numbers of power and signal cables. These facilities can be used by the pupils to encourage cross-curricular activity in the college, or can be used by outside business and other users on a commercial basis. Together with the adjacent college Board Room, this is an excellent complex for a wide range of uses. The business studies suite is located nearby and has deliberately been set up to emulate the office environment.

7. Perhaps the most important piece of remodelling at Leigh College has been the single storey block, within the lower school, for design technology. A series of electronics, technology, design and multi-materials areas are grouped around a central resource and display space that has been created out of what was originally a courtyard. This imaginative conversion may be typical of the experiences many secondary schools will have in the future. All the art, textile and food provision is on the lower school site.

8. The new location for the **library** is also found here, on the first floor of the main block. Modest **reprographics** facilities are directly off the back of the library, unfortunately separated somewhat from the library control area.

9. Four science laboratories are in the lower school and six are in the upper school. Some refurbishment of a number of these has introduced more flexible arrangements with bollard supply of services and movable tabling. A hearing impaired unit is on the upper school side of the college and common room facilities have been provided for all upper school pupils.

Organisation

10. The faculty structure adopted at Leigh College is based on three areas: Science and Technology; Society, Culture and Environment; and Business and Commerce. The number of faculties is deliberately small in order that cross curricular working is actively encouraged. This helps to redress the shortcomings of working with existing building constraints where physical links of curriculum areas are frequently not possible.

Construction Strategy

11. The existing buildings are a mixture of construction types. The lower school is predominantly one and two storey SEAC* Mark II being a steel frame with precast concrete upper floors and flat metal deck roofs. The ship-lap boarding existing here, as an external finish onto timber frame, was in reasonable condition and preservative-stained in the distinctive blue of the college colours. By far the major problem with these buildings was the existence of chipboard sheet suspended ceilings concealing voids without any fire compartmentation. The serious fire hazards could only be averted by inserting cavity barriers and replacing the ceilings. Much of the upper school consists of one and three storey flat roofed buildings. The three storey block is chiefly of reinforced concrete design, whilst the single storey buildings are a mixture of reinforced concrete roofs and wood wool slabs on steel lattice beams. Cladding to the slab block is timber framed curtain wall at high level and solid masonry at ground level. The flexibility of the three storey block is somewhat limited by the brickwork internal partitions, some of which are load bearing.

*The South Eastern Architects Collaboration

12. Only a limited amount of essential roof repairs were possible when the remodelling took place, together with much asbestos removal and insertion of ceilings and cavity barriers. The college is acutely aware of the need for considerable planned fabric maintenance from day one.

13. The **services** of the existing buildings have been substantially retained with some upgrading of lighting in particular. New fire alarm systems have been installed together with IT networks, telephone and TV; much of it combined with some additional power cables and distributed in metal trunking. Carpets have been laid in as many classrooms and circulation areas as possible, with vinyl sheet in specialist areas.

14. A strong unified approach has been taken on colour, reflecting the main theme of blue incorporated in the College logo.

Fig. 32 East elevation of east campus

Fig. 31: Floor plans EAST CAMPUS

Key

1. Reception
2. Office
3. Staff room
4. Board room
5. Medical inspection
6. Changing
7. Gymnasium
8. Sports hall/Assembly
9. Music practice
10. Music
11. N/A
12. Science prep.
13. Science laboratory
14. Rural science
15. Darkroom
16. Kiln
17. Art
18. Ceramics/ pottery
19. Design/ graphics
20. Technology
21. Multi-materials workshop
22. Food
23. Dry/textiles fashion
24. Plastics
25. Heat bay
26. Info. technology
27. Business industrial studies
28. Technicians base/materials
29. Central shared resource
30. Careers
31. Mathematics
32. English
33. Languages
34. Humanities
35. Special needs
36. Hearing impaired unit
37. Exceptional pupils
38. Pupils common room
39. Post 16 provision
40. Drama
41. Stage
42. Assembly hall
43. Dining
44. Kitchen
45. International centre
46. Library
47. Librarian
48. Reprographics

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Forms of Building Contract

1. The emphasis laid on all the projects described has been speed of delivery. All have been conceived and delivered in a gestation period of no more than two years. Many have had far less than this time. Most have had to secure sites, establish a strategy for operation, obtain sponsorship and funding, appoint key personnel, design, build and fit-out the Colleges ready for a September opening within this two year period. Previous experience has been in excess of three years for school building projects from inception to completion - often with many key people already in place. The construction period that results from this programme, particularly for the new build projects, was seldom much below 15 or 16 months.

2. Even if it were possible, a period of up to eight months to put in place a client and advisers, establish a brief, appoint the design team, brief, design and make ready a contractor would not be advisable under more traditional lump sum competitive tendering. Almost without exception those Colleges completed so far have looked to Management forms of Contract or Design and Build contracts. The type of contract used is given in the costs data sheet. Out of seven major contracts let, four were variations on a Management form of Contract, two were Design and Build and one is a 'Measured Term Contract'.

3. **A Measured Term Contract** essentially adopts a traditional main contractor responsibility but effectively negotiates for packages of works within a previously agreed schedule of rates, adjusting by competitively tendered percentages for preliminaries, etc. This involves the client in appointing a design team of architects, quantity surveyors, and engineering consultants, who prepare documentation of sufficient quality to secure a contractor under competition. In the case of Leigh College the contractor started work some three and a half months after the designers were appointed. The work packages are let as work proceeds. The designers, quantity surveyor and contractor work closely together to ensure detailing, costs and construction will keep within the overall cost plan that has been established as the project target cost.

4. **Management Form of Contracts** have been used most frequently in the programme. The JCT* form went through revision whilst the first contracts were let so two have used the 1963 form, one an interim version and one the new 1987 version. The contract involves a competitive appointment of a management contractor, based upon an approximate cost plan, outline specification, and contractors proposals for preliminaries and contractors management fee percentage. When appointed, the Management Contractor, becomes immediately involved in design team deliberations, bringing practical building expertise and a reinforcement to cost advice at the early stages. He develops a procurement and construction programme to coordinate the tendering for and letting of elemental works packages. This continues once on site, the Management Contractor being jointly responsible with the design team and professional quantity surveyor for keeping packages within the contract cost plan. The client is still responsible for appointing an architect, quantity surveyor and engineering consultants. The contractor has management responsibility for the work, in particular a duty of quality control for building fabric and services.

5. **The Design and Build** approach was used successfully on two of the projects, Emmanuel College and Kingshurst Phase II. In this approach the contractor is selected on the basis of being responsible for the design and the construction of the project. Very detailed requirements for the project, including an outline cost target, are prepared by the client's professional agents, and contractors are invited to submit outline designs and cost proposals. A short-list of tenderers are invited to a second interview where detailed proposals are considered and matched against the criteria. When appointed, the contractor has complete responsibility under contract to the client to develop the design and construct the building on site, on time and within the agreed tendered cost. Emmanuel College used a slightly modified form which included for

sectional completion.

6. With Design and Build contracts it is not essential for the client to appoint a Design Team. However it is advisable to do so to prepare a thorough and comprehensive list of requirements. Such input is also necessary to monitor and advise the client throughout the contract period. At Kingshurst the quantity surveyor involved in the first phase Management contract was appointed as client's professional agent. The A & B Branch was able to give architectural advice to establish the 'Schedule of Requirements'.

7. At Emmanuel College the Project Director was advised throughout by a quantity surveyor and an architect with considerable educational design experience. The contractor had already engaged the services of the architects who had successfully designed Macmillan College under a management contract. The adviser to the client was able to co-ordinate fully the requirements of the Project Director and his educational advisers and convey these to the contractor and his architect. Team work on this project was quite exemplary, particularly in view of the requirement to involve many of the teaching staff in decisions that affected internal partition layouts and services.

Timing of Staff Appointments

8. In general all the projects under all the forms of contract demanded and obtained a high level of co-operation and committed team-work. All managed to deliver the buildings ready for opening on the due dates and as the datasheet demonstrates, within costs comparable to the maintained school sector. The Project Directors are key to the whole operation and the timing of the appointments of the advisory team, the design team, the building contractor, the Principal, senior staff, furniture supplier and the College staff is crucial to the achievement of these targets.

9. With hindsight, the views of the Project Directors and Principals at the six CTCs varied over timing and order of appointments. Only once was it suggested, with a wry smile, that the Principal might have been appointed first. All the CTC Trusts recognised the need to depart from traditional practice and involve the Principal as early as possible. In the main, the educational advisors, with the Trustees and Project Director, established a local curriculum framework developed from the main objectives of the CTC Framework Document. This gave each CTC its own identity with individual priorities. In most cases it was necessary to establish the overall building envelope design and take serious steps towards works on site before a Principal could be appointed. A combination of the approach to design (including non loadbearing internal walls and flexibility of servicing) and the forms of contract adopted did facilitate the general preference for the Principal to be involved in the design. The design teams all recognised the importance of this involvement but without exception stressed the need to be firm about how far this involvement could go. A strict programme of dates for decisions to be made, with a clear indication of the contractual implications of any delay, is essential. Where senior staff were involved in decisions concerning partition locations and service requirements, conflicts of timing were always experienced. This is inevitable because of the timing of their appointment in the overall building programme. The advantages of staff feeling involved, making spaces they had helped design operate effectively, must be carefully balanced against disruption to a building programme and diseconomies of their very early appointment.

10. It became clear from the different comments made by the design teams and Principals that the key to success was to identify, at the outset, a hierarchy of decisions that will be necessary throughout the project, as well as who should make them and when. Thus the Project Director might take overall responsibility for setting deadlines for decisions, working closely with the educational advisers and the Principal, who in turn might want to consult senior members of staff who must be appointed in time.

11. Whilst considering these logistical matters it should be remembered that the delivery of education is an evolving process and establishing a building is only one step in that process. Every effort should be made to ensure that a sufficient variety of spaces is provided and to maximise on the use of movable or relocatable furniture and fittings. The importance of flexibility and potential adaptability is discussed later, as are the implications of furniture procurement, both as a logistical exercise and to maximise involvement of the user in moulding the working environment to their needs.

Furniture, Equipment and Consumables Procurement

12. Furniture, equipment and consumables procurement has presented a challenge to the CTC programme on cost, design and procedure. It involves a total expenditure of £25M over a four or five year period. This is a task of a size and time scale not undertaken before in educational building. However, to properly co-ordinate such a task was essential and the DES looked closely at the best existing practice in both the private sector and Local Education Authorities.

13. The Department's A & B Branch helped develop a tender procedure for furniture and equipment that allows the project directors to select a procurement agent following a competitive tendering exercise. The agents provide a full management, design, ordering, purchase, delivery and installation service or components of this service.

14. Furniture equipment and consumable items are selected from a range based upon competitive price and quality. In respect of furniture, quality is ensured by setting a range of product choices all conforming to clear, acknowledged British Standards.

15. This procedure has been followed in order to achieve the policy of providing good value for money on cost and performance. The DES has also been keen to encourage flexibility through the use of loose furniture and that within the budget constraints the effect of the buildings, designed to respond to technological change, is not lessened by the use of out-moded, fixed furniture.

16. Experiences from the six projects described in this Bulletin are worth discussing briefly because they are relevant to all sectors of education particularly with a range of new educational initiatives being promoted. Under these new initiatives many of the traditional procurement methods may not be appropriate.

17. The following **guidelines** are probably the most important experiences from the programme and must be considered before becoming fully committed on the scope of the building works as the budget for these may be affected.

a. Firstly a cost budget should be set for the three components of Furniture, Equipment and Consumables. The guidelines for the programme are broadly a percentage breakdown of approximately 35% for furniture and 65% for equipment, with an additional sum of approximately 20% of the total furniture and equipment budget being set aside for consumables.

b. The boundary between loose and fixed furniture must be clearly established for all concerned.

c. Thirdly the design ethos and image must be established and carried consistently through the building interior design to the furniture selected for the college.

18. **Management of the Process**. The decision making process should be clearly established at the outset, for instance, will staff be represented in the choice and selection of items. Reference has already been made earlier to the importance of establishing a hierarchy of decisions and who makes them. Experience on the CTCs has varied but clearly the selection of equipment is a matter largely for the teaching and technical staff to make. If staff are to have substantial input into selection and design of furniture, they must be appointed early enough in the programme. Experience has shown that to ensure a reasonably smooth programme of supply and installation, Furniture and Equipment schedules should be agreed six months before opening day. Working back from this date, aspects to be determined include; how long it will take to install equipment or movable furniture that requires connection to services (such as science bollards), delivery times, preparation of schedules and ordering, agreement to layouts and design of layouts. This process should never be underestimated.

19. Experience has shown that whether the architect or the procurement agent has responsibility for preparing layouts, both of them should be kept informed of each other's progress and responsibilities. Where certain college staff were involved in the process they had to be appointed early enough, to have sufficient time to arrive at decisions on time. Many involved reported the advantage of presentation of draft layouts for comment rather than asking staff to list or draw their requirements.

20. Four main conclusions are drawn from the experiences of the CTC programme in respect of Furniture and Equipment:

– Determine what is fixed furniture and in the building contract and what is loose and in the Furniture and Equipment budget.

Standard furniture and fittings must be dimensioned to suit a wide age range.

Furniture incorporating cable management enables the open atria areas at Djanogly to be serviced.

- Ensure that the architect's role is clearly defined with that of the furniture procurement agent over responsibility for preparing layouts and colour schedules.
- Establish a regular dialogue with the architect (as the client's professional advisor), the educational advisors and the staff with the procurement agent.
- Coordinate furniture, building and services with full consideration to the health and safety, fire regulations and British Standards implications of all equipment and furniture layouts.

COST IMPLICATIONS

21. The total financial implications of any building project can be broken down into three main areas:

- Capital building
- Furniture and equipment
- Recurrent expenditure

This document mainly addresses the first two areas and there is further discussion of these below. However, the overall context in which these buildings will operate has been critical to informing their design and the way in which they are equipped. Recurrent expenditure is fully funded by the LEA and is at a level derived from an average expenditure by LEA on secondary schools located in similar urban areas. It is for the college to set priorities for all recurrent expenditure, whether on staff, buildings or any other priority, within the total budget thus determined. Design detailing and specification has been with low maintenance and low energy consumption firmly in mind.

Capital Costs

22. From September 1987 to September 1988, when the Kingsburst (Phase I), Djanogly and Macmillan Colleges were under construction, building tender prices (as measured by the Public Sector Building Tender Price Index) rose by 18%. The subsequent increase from September 1988 to September 1989 was 5% and from September 1989 to September 1990 a decrease in building tender prices of about 4% is forecast. The costs shown in Data Sheet 3, supplied by the respective project quantity surveyors, are for the actual or anticipated out-turn costs of the colleges. When cash limits were initially established, regional adjustment factors were taken into account. Such factors are a guide to price levels in a particular area but must be used with some care at particular sites and in local circumstances. It must also be recognised that the historical nature of regional adjustment factors may not reflect changing relativities when inflation changes direction. Some variation in the purchasing power of the cash limits set for individual projects is therefore to be expected.

23. Overall, the figures compare very favourably with costs experienced elsewhere in the maintained sector over the period, particularly bearing in mind the emphasis in CTCs on technology and science, and the urban nature of the locations. Analysis of data from the larger secondary school building projects in the maintained sector over the three years 1988 to 1990 shows an average cost of £682 per m². This compares with the average price of £696 per m² for the colleges as set out in Data Sheet 3. These figures show that it is not possible to distinguish between the capital cost of buildings in the two sectors.

24. The general tendering climate for buildings in December 1987 and January 1988 was one of abundant workloads and considerable boom. For Kingsburst phase I, opening in September 1988, tender conditions were not therefore

favourable to the client. Djanogly and Macmillan both opened in September 1989 but experienced similar conditions to those at Kingshurst, as the planning and building times involved the same market pressures.

25. All three contracts were management forms and in each case competition for the management contract was very good. However, on each of the three contracts, it was difficult to obtain tenders for work packages because local contractors had full order books. Prices were therefore affected, particularly for key areas such as brickwork, carpentry and joinery. The tender conditions for those CTCs completed in 1990 were more favourable to the clients.

26. In general the CTC initiative has been supported by industry, including the building industry, which has doubtless benefited the local Trustee's clients by ensuring wide publicity and competition for the building works. This has further been demonstrated through the successful completion under design and build contracts of Kingshurst Phase II and Emmanuel Colleges in 1990. In the case of Emmanuel College, it has been possible to provide additional overall area because of the very reasonable costs per square metre. Bradford CTC has also benefited and has been able to provide additional area in the important central Mall by planning

COMPARATIVE CAPITAL BUILDING COSTS

	Kingshurst Phase I	Kingshurst Phase II	Djanogly Nottingham	Macmillan Teesside	Bradford	Emmanuel Tyneside	Leigh Dartford
Type of Tender	Management	Design and Build	Management	Management	Management	Design and Build	Schedule of Rates + %
Area	4266	4881	5132	8145	9688	5450	6732 +
Start Date	Jan-88	Aug-89	Jan-88	Jun-88	Jun-89	Jun-89	Sep-89
Finish Date	Sep-88	Sep-90	Sep-89	Sep-89	Sep-90	Sep-90	Sep-90
% Remodelled	95.0%	5.0%		54.0%			97.0%
% New Build	5.0%	95.0%	100.0%	46.0%	100.0%	100.0%	3.0%
Substructure	£351,889	£711,198	£384,240	£194,384	£600,228	£318,800	
per m²	£8.90	£83.27	£42.08	£22.64	£82.60	£33.78	
% of building cost	1.2%	8.2%	7.4%	5.5%	16.5%	7.2%	
Superstructure	£1,215,909	£1,195,128	£2,513,302	£1,890,825	£2,107,979	£2,126,200	£1,737,200
per m²	£298.14	£262.80	£275.22	£232.27	£240.30	£223.94	£198.97
% of building cost	58.4%	45.8%	48.7%	56.5%	66.0%	48.0%	63.2%
Internal Finishes	£172,340	£271,196	£438,766	£372,130	£480,363	£503,100	
per m²	£40.40	£55.52	£85.25	£45.69	£49.59	£53.66	
% of building cost	9.9%	8.5%	8.5%	11.1%	10.0%	11.5%	
Fittings	£110,278	£103,128	£133,859	£44,183	£37,414	£50,400	
per m²	£25.84	£35.12	£14.66	£5.42	£3.86	£5.35	
% of building cost	6.3%	3.9%	2.6%	1.3%	0.8%	1.1%	
Services	£470,000	£969,264	£1,492,114	£853,578	£1,199,829	£1,414,300	£1,110,900
per m²	£98.45	£178.09	£285.30	£104.79	£123.85	£249.66	£125.78
% of building cost	24.1%	33.6%	32.8%	25.5%	28.7%	32.2%	36.8%
External Works	£40,000	£243,761	£660,768	£161,967	£883,911	£438,500	£264,300
per m²	£5.38	£49.84	£96.45	£29.89	£87.11	£69.68	£19.82
% of building cost	2.0%	7.1%	13.2%	4.1%	12.8%	10.1%	8.9%
Preliminaries	£283,883	£511,636	£645,000	£888,623	£918,382	£1,486,900	£818,630
per m²	£43.22	£75.32	£70.63	£59.99	£94.82	£251.11	£47.58
% of total	9.4%	17.8%	9.6%	12.2%	13.9%	22.2%	12.6%
Total	£1,963,750	£3,482,763	£6,688,050	£3,966,612	£6,611,107	£6,512,800	£5,333,130
per m²	£460.23	£735.34	£732.38	£490.68	£682.40	£689.14	£361.51
Bldg incl Prelims	£1,902,283	£3,547,631	£5,661,136	£3,755,123	£5,522,262	£5,386,132	£4,191,886
per m²	£445.92	£639.39	£619.83	£463.13	£570.12	£569.96	£274.31

Average Cost of New Build = £596.25

Costs are based on actual or predicted final account

No adjustment has been made for location or date of tender

Fire index ranging only +/- 1.3% over the relevant period

Information based upon data supplied by project teams, used for general comparative purposes

+ Area where remodelling works were carried out

much lower costs per square metre for this space, and reduced overall costs.

27. The estimated final account at Leigh College shows a good average cost for what is almost totally remodelled accommodation. Some of the factors that impinged upon costs at Leigh CTC are relevant to some extent for any "fast-track" building project. They are particularly relevant to projects where the character and emphasis of a secondary school is changed while the original school stays open on the same site. The factors include:

- difficulties in establishing a budget for a 'fast-track' project and consisting of works to existing buildings; there is less scope to establish an accurate cost plan at the outset, and there may be uncertainty about existing construction and services which are revealed as work progresses, however good the survey is;
- the direct cost of evening, weekend and holiday working;
- the direct cost of temporary works to separate construction areas and teaching areas, and the continuous cost of modifying temporary works as the project proceeds;
- the direct cost of a very high level of on-site supervision by both contractor and design team;
- the direct cost of uneconomic working during school hours, and also work being executed by hand tools, work being executed out of natural sequence and sometimes on a piecemeal basis;
- the indirect cost of having to make design decisions and select materials and subcontractors with inadequate time to research the most economic alternatives.

28. Within the climate of the building industry over the last three years, and with the many physical constraints of the remodelled examples, the achievements of cost control by the project teams have been very good. Already the benefits of experiences gained so far are being passed on to those involved in the current programme of CTC projects.

Furniture and Equipment Costs

29. Funding for the furniture and equipment costs at the CTCs is generally on the same basis as for capital building - a maximum of 90% from central government and at least 10% by the Trustees of the CTC. To establish a basis for the level of funding, the policy was stated:

"To produce colleges equipped to a level of information technology to be found in only the very best maintained schools; in science and technology to the best existing standards and to a good standard in all other subjects".

30. Against that policy background, a budget was developed from careful analysis of costs in the maintained sector, reflecting those priorities identified in the policy. An overall value of £1.54 million at 1989 prices was established for furniture and equipment in a new 1000 place CTC. Of this, a figure of £250,000 was earmarked specifically for information technology - to include computer hardware and software, plus the cabling for an IT network which was usually required. The total allocation is to include for VAT and fees.

31. The considerable advantages arising from the use of loose furniture and fittings, to provide flexibility of the buildings in use, have been discussed elsewhere. The experiences of each CTC project team have demonstrated a need to look seriously at the mechanics of integrating the provision of furniture and fittings with that of providing and costing the building. At the very minimum it is essential to clarify what is required, how its delivery and installation will be managed, and to which budget its cost will be allocated. The cash limit provides the overall framework within which these choices are made.

DESIGN CRITERIA

1. To be successful a building should positively support the operations and processes that will go on within it. For educational building such support goes beyond constructing a series of spaces in which pupils may spend their school day. Good educational building design must establish surroundings which encourage its users, who are the real clients, to enthuse, feel pride, and learn to the very best of their ability, and so develop their highest potential.

2. Each of the colleges described has had its own particular priorities. This is led by the perceived needs of the local community of each college. Further, it is determined by the different emphasis that sponsors and their professional advisers have identified as appropriate in making educational experience relevant to the needs of the world of work. Finally, to some extent, constraints or indeed opportunities of working with existing buildings have created different priorities. These priorities, which might simply include image, have to be reconciled with a need to understand the demands for change that will come about during the life of the college.

3. The consideration given to projection of an image in the colleges is important. Although it has been criticised as the result of having more money to spend, this is not borne out by the discussion earlier on costs. There is general use of carpets except in areas where the nature of the work dictates otherwise. A variety of lighting has been used to create atmosphere, where appropriate, and to give sufficient illumination levels, that are still comfortable in use, where computer screens are concerned. Bright and stimulating teaching spaces, with a positive use of colour throughout, have helped create the qualitative image in these colleges. The use of interior designers in many cases has helped to show how well colour can be used. These are all elements used commonly in educational building. It is a careful application of these products and materials that is important, and a commitment to their ongoing maintenance so that the initial image does not fade.

Accommodating Change

4. Fundamental to the design process is recognising the anticipated life of the elements of a building, and selecting them so that they will be able to accommodate changing requirements over that period. These elements fall into three main categories:

Bright and stimulating teaching spaces are created through good lighting and the use of colour on floors, screens and furniture.

a - building fabric - 30/60 plus year life

b - services, mechanical and electrical - 15/30 year life

c - furniture and equipment - 5/10 year life

The first phase of Solihull perhaps best illustrates the considerations for building fabric. Here the external cladding was almost 30 years old and to retain it would have been costly in maintenance. Many of the internal partitions, which were non loadbearing, enclosed spaces that no longer suited current educational practice. The majority of services were in need of renewal. The building frame, however, was in good condition and could offer many more years of service. In considering the design of the new CTCs and the remodelling of existing buildings, the need to keep these three elements of fabric, services and furniture separate as far as possible, should be recognised.

Loose furniture used with pinboard and shelves hung from 'rail' allow flexibility

5. The main types of space in the colleges can be grouped into four categories. These were first described in Building Bulletin 68 'Weald College Harrow Development Project' and are relevant here:

– **Pivotal functions** gathered together create a main centre to the college and local sub-centres around which the college day revolves. These largely determine access and movement around the site. The spaces they occupy are often large, 100m^2 or more in area and, unlike specialist areas, are intended to serve the whole college. These functions include the library, private study areas, dining facilities, local social bases, administration and gymnasium.

– **Committed specialist spaces** are arranged outside the main centre and, together with locally disposed pivotal functions, form the basis of departmental sub-centres. Such spaces, by virtue of their special requirements in respect to floor areas or heights, their furniture and equipment, and services, are committed to particular uses and may be fixed in position. They are generally larger in areas than general teaching space, ranging up to about 90m^2. They are more expensive to provide than general teaching spaces. Examples of such committed specialist spaces are laboratories, areas for art, and technology, (including craft, design, multi-skills, light engineering, business and other studies) and music and drama facilities.

– **Broadly interchangeable spaces** in which related or back-up activities can take place, will interact with the spaces described above. Their floor areas range up to about 50m^2, and uses may change according to demand in different areas of the curriculum or college life. Examples are most general teaching spaces or classrooms, which can also serve as staff work rooms or local social bases.

– **Small spaces**, rooms or offices, from 10m^2 upwards are distributed throughout the colleges. These spaces are also interchangeable in use. Examples are heads of departments rooms, senior staff, interview or counselling rooms.

To operate effectively the four space categories just described require a fifth category of support storage, service and balance areas.

Flexibility

6. Flexibility of the buildings is a measure of their ability to cope with change initially through a mix and variety of spaces within the buildings. These include the pivotal functions, committed specialist spaces, general purpose teaching spaces and non-teaching areas. The use of open areas also allows related activities to flow into one another or to expand and contract, in response to demand. The approach on furniture and fittings is also vital. Loose furniture, 'unhookable' wall fittings and demountable or unpluggable serviced furniture is used to varying degrees in all of the colleges.

7. At both Djanogly College and Emmanuel College the planning approach is to group rooms around a central area. At ground level many of the spaces can be subdivided by removable screens, or accommodate activities as they ebb and flow from the surrounding rooms. Even at first floor, circulation is wide and bays can be formed with furniture and screens to provide study areas linked with more formal teaching spaces.

At Djanogly College, science bollards are removable, replaced by floor level covers, so that room uses are variable.

8. Opportunities for maximum control over how a teaching space is used are available at most of the colleges. Very little in a room needs to be fixed and by using only a 'J' rail profile section screwed on all the internal walls, a variety of shelves, display units, marker and pinboards and coat hooks can be simply hooked on or off. Staff have used this flexibility to good effect already. They are able to make the room respond to the needs of a particular project or simply change the atmosphere of the space and place a personal identity upon it.

9. Another area where furniture has been traditionally fixed is in science laboratories. At Djanogly College the furniture designers of A & B Branch worked with the architects, college staff and furniture procurement agents to develop a fully demountable science laboratory. The serviced bollards were carefully designed to fit into a planning grid that allowed tables to be moved to various layouts in each laboratory. The ultimate layout of completely free floor space is facilitated by 'unplugging' all the services from the central and perimeter bollards, removing the furniture and laying a pre-finished cover flush with the floor surface.

10. At Kingshurst CTC the demands of a phased building programme where some spaces would change their function on completion of the 2nd phase, and building fabric and service limitations combined to produce a particular need for flexibility. Three science laboratories were required for the first two years operation. At least one would move to the second phase eventually. The Principal had a strong preference not to suite all laboratories together and they were to be situated on two floors. The floors could not be punctured for drainage and therefore the modular science furniture known as 'Labkit Workstation System' was used most effectively. 'Labkit' was designed and

developed by the Laboratories Investigation Unit, A & B Branch, with its manufacturer and has been developed in use in a number of further education and secondary projects. The ability to bolt together components in a range of layouts was fully exploited at Kingshurst. Together with its bright colours, the system is well liked by staff and pupils.

11. Each of the CTCs has answered the requirements of flexibility in furniture provision in their own way. For example, some have embraced the 'J' rail system to a varying extent, whilst others have adopted duplication of fixed white boards on two walls, and yet others believe that room characteristics dictate orientation for teaching. When such decisions are made, some consideration should be given to determining the long term cost implications of restricting flexibility.

12. Selection of furniture for a CTC or any other educational building should, within budget constraints, provide the maximum facility for change. As CTCs and schools respond to the National Curriculum they will need to allow for the changing environments that will occur. Furthermore, the need for different types of accommodation is such that adaptability should have the minimum

Kingshurst used a 'stonehenge' layout of 'Labkit' workstations in phase I. The demountable nature of the system allowed it to be easily fitted in the existing buildings, then relocated in phase II.

implications in terms of time and resources.

Adaptability

13. When the degree of change exceeds the limit which the flexibility described earlier can provide, the capacity of the buildings for physical alteration comes into play - in short their long term adaptability. Such adaptability is enhanced by the use of structural frames rather than load-bearing internal walls; the clear separation of the building fabric from the building services and the provision of adequate space for later addition or modification of services.

14. Macmillan and Leigh Colleges have exploited the capacity to adapt existing buildings to meet new requirements in the same way that has been achieved in the first phase of Kingshurst. Each of the new-build colleges has adopted the approach, although to differing degrees. One common factor is that each of the new build CTCs has a modular window pattern incorporated into its design. This provides a pleasing elevation externally, whilst at the same time facilitating a range of potential locations for internal partitions, which allows the building to be very flexible in terms of space size. The majority of spaces receive good natural light with attractive internal wall elevations. Few of the disadvantages exist of curtain walling solutions, where there is less scope for locating partitions avoiding thin mullions, and the consequences of uncomfortable and badly lit spaces.

15. At Emmanuel College the overall envelope design was agreed well in advance of detailed decisions over the curriculum organisation. A clear brief setting out the total range of spaces required was identified at the outset. This, combined with the employment of architects who understood educational design, made it possible to progress a frame and envelope design without knowing what the eventual internal layout would be. The project team put emphasis on the internal design being curriculum led. Thus decisions on the internal layout were made late on in the building contract, once staff had been appointed.

16. The principle of design at Emmanuel College was a ribbon of spaces around each pavilion that was closely juxtaposed with the next. This ensured that whatever faculty/department structure was adopted, spaces could effectively overflow into the neighbouring pavilion. Thus potential difficulties, arising from the designing of the interior within a fixed envelope, were considerably eased.

17. Subdivision of the spaces within the pavilions is by metal stud and plasterboard partition - affording long term demountability - whilst a robust fair faced blockwork has been used very effectively along the continuous linking corridor at ground and first floor.

18. Djanogly College had adopted the same approach of separation of internal walls from structure. In each pavilion, only the stair tower and WC block are loadbearing and brace the steel structural frame entirely. All other partitions are of

Adaptability is ensured in new buildings by 'hole-in-the-wall' windows, allowing partition walls to abut between; moveable sinks and services are generally separated from the building fabric.

stud construction, most only reaching the suspended ceiling where they locate for bracing and form an acoustic seal. Some improved acoustic attenuation is achieved by hanging fire blankets over certain partitions. The ability to demount the partitions if required is further assisted by the need only to give minor cosmetic attention to the ceiling. The college has already taken advantage of the ceiling fixing to construct a further small store, with very little disruption to the building fabric. Indeed the facility offered by the planning and construction characteristics was exploited at a late stage of construction on site. Two general spaces and the associated corridor in pavilion 3 first floor were absorbed into what is now the languages centre. The success of this space has been discussed elsewhere.

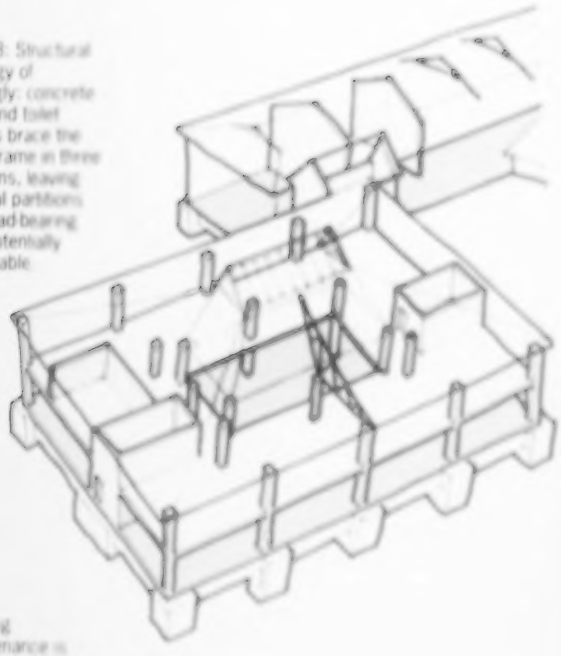


Fig. 33: Structural strategy of Djanogly: concrete stair and toilet towers brace the steel frame in three pavilions, leaving internal partitions non load bearing and potentially removable.

Maintenance

19. Principles of design for low maintenance were followed wherever possible in the six colleges illustrated. Maintenance considerations must strike a balance between reasonable capital expenditure, likely wear and tear and anticipated useful design life. The anticipated life of building fabric, services and furniture and equipment have been discussed earlier. How the buildings will be looked after is also crucial to the equation.

20. Maintenance of the buildings and the grounds is the responsibility of the individual colleges within the available resources. In the majority of cases this duty of care for a substantial capital asset is vested in a Building and Sites Supervisor. This title, first adopted by Djanogly College, reflects the considerable expansion of the role once referred to as Caretaker. As at Djanogly, there is often a team of assistant Building and Site Supervisors, ideally with a range of practical skills and a responsibility for on-going maintenance of the building, its services, and the grounds. In some cases work will be contracted out to specialists under the control of the Building and Sites Supervisor but in most cases it will be tackled directly by the team.

21. With this practical hands-on approach it is essential that, wherever possible, materials used in the building design are selected with a view to being worked by those with the traditional craftsman skills. It will be of no advantage for critical components to rely upon specialist repair off-site, unless this simply cannot be avoided.

Building maintenance is reduced by the use of durable brickwork, metal sheet roofing with large overhanging eaves and hard wearing windows.

22. For these reasons, most of the buildings have included pitched roof designs of metal sheet or concrete tiles with large overhanging eaves; use of durable brickwork externally where possible or alternatively low maintenance metal sheet cladding, and hole-in-the-wall windows of hardwood or powder coated metal. Internally, robust finishes and appropriate protection of vulnerable surfaces combine with consideration for detailing, and specifications for fittings and finishes, so that undue maintenance will not be required. All these materials are capable of site based repairs through the skills of college staff or by engaging

local contractors.

23. All elements of sophisticated buildings will benefit from **planned maintenance.** A thorough knowledge of most components will come from a basic asset registering and an assessment of the anticipated life. This assists financial planning but also ensures that a rolling programme of maintenance achieves maximum life and suitable preventative action such as cleaning, renewal or replacement in good time. With the sophistication of servicing for educational buildings increasing, some of the colleges have been encouraged to establish maintenance contracts from the beginning. Most large services sub-contractors offer renewable service maintenance contracts and there is considerable advantage of continuity if the installer takes on the maintenance responsibility.

User and Service Manuals

24. Comprehensive and relevant services manuals with details of components, their method of installation and their maintenance, are essential at completion of a project. Most services subcontracts include for these. What is also essential is the Building User Manual which describes, in appropriate language, the full facilities and flexibility available within the building. These have been commonly provided by the architects for the CTC projects. They should be comprehensive in providing key information from design and construction team contacts through emergency procedures, description of the buildings in use, to manufacturers maintenance instructions and materials specifications.

Existing Building & Current Standards

25. Within cash constraints and the need to conform to current fire, health and safety requirements all three remodelled projects needed substantial work on fire compartmentation and careful removal of asbestos. Reclading the blocks with more durable materials was not an available option at Leigh College and flat roofs received only minimal attention.

26. Remodelling existing buildings gives rise to the same problems as in the existing maintained school sector; the CTCs can benefit from the advice available there. The following publications by A & B Branch, DES are relevant here: in the 'Maintenance and Renewal in Educational Building' Design Note series: DN40, 'Needs and Priorities', 1986 and DN46, 'Flat Roofs Criteria and Methods of Assessment, Repair and Replacement' 1986.

AREAS COMPARED *(Note: all percentages are of Gross Area)*

	KINGSHURST Solihull		DJANOGLY Nottingham		MACMILLAN Teesside		BRADFORD		EMMANUEL Tyneside		LEIGH Dartford	
Total Capacity	**1110 pupils**		**1000 pupils**		**1050 pupils**		**980 pupils**		**900 pupils**		**1250 pupils**	
Existing Gross Area	4115 m²		none		4353 m²		none		none		1447[illegible] m²	
TOTAL GROSS AREA	**8952 m²**		**9132 m²**		**8099 m²**		**9688 m²**		**9450 m²**		**12980 m²**	
Gross area per pupil	8.06 m²		9.10 m²		7.71 m²		9.90 m²		10.50 m²		11.38 m²	
Laboratories	985 m²	11.0%	840 m²	9.2%	660 m²	8.1%	1095 m²	11.9%	728 m²	7.7%	1100 m²	8.5%
Art and Technology spaces	1230 m²	13.7%	1164 m²	12.7%	1377 m²	17.0%	1295 m²	13.4%	1149 m²	12.2%	1590 m²	12.2%
Physical education	562 m²	6.3%	554 m²	6.1%	310 m²	3.8%	742 m²	7.7%	854 m²	9.0%	1011 m²	7.8%
General teaching/ learning	2870 m2	32.1%	3117 m²	34.2%	2421 m²	29.9%	2189 m²	22.6%	2586 m²	27.4%	2940 m²	22.7%
Total learning area	**5647 m²**	**63.1%**	**5665 m²**	**62.0%**	**4768 m²**	**58.9%**	**5281 m²**	**54.5%**	**5317 m²**	**56.3%**	**6640 m²**	**51.2%**
Library	210 m²		229 m²		216 m²		320 m²		214 m²		226 m²	
Sports hall/ gymnasium	560 m²		896 m²		260 m²		597 m²		695 m²		982 m²	
Dance (aerobics)	–		–		177 m²		–		104 m²		–	
Multi-gym	16 m²		42 m²		–		98 m²		55 m²		–	
Assembly hall	–		–		–		–		–		475 m²	
Other assembly spaces	–		115 m² (atrium)		–		500 m² (multi		–		–	
Drama studio	288 m²		122 m²		150 m²		140 m²		397 m²		78 m²	
Dining	260 m²		130 m²		90 m²		202 m²		150 m²		240 m² (serv[illegible]	
			22 m² (servery)		47 m² (foyer)		62 m² (cafe)		77 m² (foodhall)		176 m² (eat[illegible]	
Total Kitchen/ Dining area	354 m²		232 m²		211 m²		135 m²		304 m²		860 m²	
Teaching storage	288 m²	3.7%	385 m²	4.2%	291 m²	3.5%	318 m²	3.3%	300 m²	3.2%	589 m²	4.5%
Lavatories/changing	397 m²	4.4%	291 m²	3.2%	138 m²	4.2%	446 m²	4.6%	388 m²	4.1%	930 m²	7.2%
Circulation		**11.5%**		**19.6%**		**20.8%**		**24.7%**		**18.5%**		**13.6%**

(Data supplied by project design teams, or measured from plans by the authors for ease of comparison)

TECHNOLOGY

Fig. 34. Ground floor plan of two pavilions of Djanogly CTC, showing furniture layouts of Design/Technology areas.

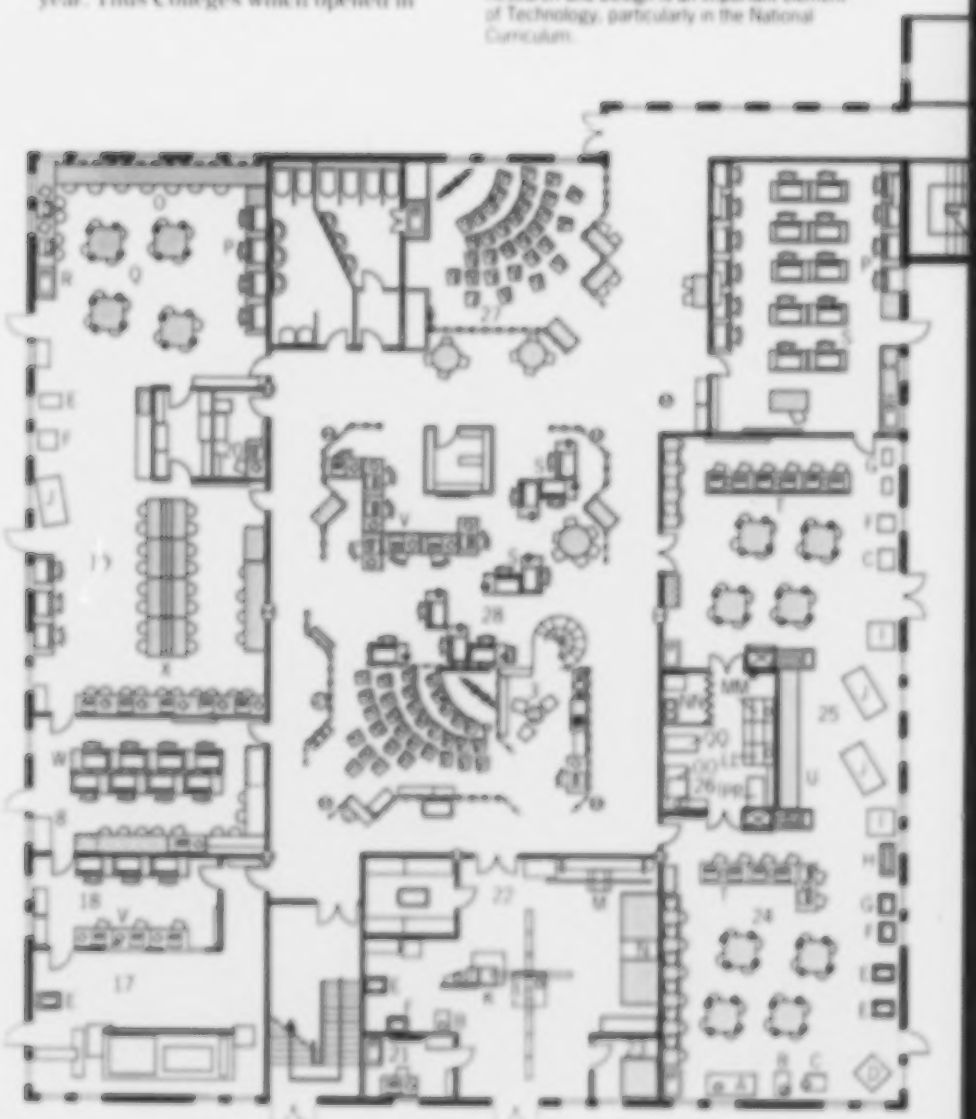
Key

1. Information Technology
2. Business Understanding
3. Resources
4. Conference
5. Director
6. Scullery
7. Staff
8. Design
9. 3D Work
10. Kiln
11. Textile Project Work
12. Food Seminar
13. Food Practical Room
14. Dark Room
15. Shared Graphics
16. Careers
17. Computer Aided Design
18. Control Room
19. Technology
20. Head of Department
21. Technicians Office
22. Technology Preparation
23. Extractor
24. Multi-materials
25. Plastics
26. Heat Bay
27. Social Base
28. Project Display
29. Domestic Area
30. Laundry Area
A. Woodlathe
B. Bandsaw
C. Linisher
D. Morticer
E. Drill
F. Double Grinder
G. Double Polisher
H. Strip Bender
I. Milling Machine
J. Metal Lathe
K. Circular Saw
L. Planer Thicknesser
M. Hacksaw
N. Panel Saw
O. Heavy Duty Tables
P. Heavy Duty Tables with Drawing Boards
Q. Multi Bench for four Stools
R. Belfast Sink
S. Drawing Board Table

1. The aim of a City Technology College is to provide an educational building based on secondary school provision, but with a special emphasis on Technology and, to a lesser extent, Science. Thus Technology holds a key position and will be pervasive across the whole curriculum. There will also be a much greater provision of information technology throughout the whole College than in secondary schools generally.

2. The National Curriculum requirements in Technology were finalised in March 1990 and introduced for 11/12 year olds in August of that year. Thus Colleges which opened in

Research and Design is an important element of Technology, particularly in the National Curriculum.



T. Computer Tables Serviced by Power Pole
U. Plastics Workbench
V. Computer Tables
W. Drawing Board Tables with Air Outlets
X. Technology Tables with Low Voltage
Y. Cooker in Purpose Built Furniture
Z. Various Height Tables & Stools
AA Sewing Machine Tables
BB Potters Wheel
CC Pugg Mill
DD Blunger
EE Light Box
FF Vacuum Presting
GG 1200 x 600 Tables and Chairs
HH Proprietary Office Furniture
II Art Easels
JJ Washdown Sink
KK Low Table & Upholstered seats
LL Brazing Hearth
MM Chip Forge
NN Welding Bench
OO Crucible Furnace
PP Pickling Bath
QQ Moulding Bench

1988 benefited from having a much clearer view of what the National Curriculum would require than those which opened the year before and, in particular than Kingshurst Phase 1, opening in 1988.

3. Nevertheless, all of the CTCs have followed the same brief when designing their Technology suite. The overall planning approach is to group practical areas around a central resource area and technician base.

Central Resource

4. This central resource area, along with the relationship of practical teaching spaces to it and to each other, has been fundamental to the design of CTC Technology suites. As such it is consistent with the trends of educational practice in the subjects forming the new definition of Technology. The aim is that individual subjects can be taught separately, perhaps with a full class group, but also that groups and individuals should be able to move around within the suite. These individuals should have access to resources and staff expertise as they wish, depending on their particular project's needs. Equally, different subject areas might be joined together to deliver a more holistic approach to a combined group.

5. All this means that individual pupils, and small groups, will require access to reference materials, resources and an IT capability at unpredictable times, without disturbing others working in practical areas. A central resources area can provide this and where there is also sufficient space and facilities for discussion, planning, drawing, and modelling this helps pupils to develop, produce and evaluate their work outside the whole class situation. Adequate access to tools and equipment appropriate for all kinds of materials should also be considered. Such spaces should ideally be untimetabled to allow maximum access to pupils working outside their class group.

Grouping of Spaces

6. There should also be flexibility for movement within each teaching space, and between various spaces, without causing unacceptable disruption to

Working in a team on collective class projects enables students to experience the various stages of design and manufacture

classes or groups. An examination of four of the CTCs considered in the Bulletin will illustrate the ways in which this basic philosophy has been achieved in both new build and remodelled projects.

7. At **Djanogly**, the CDT, Design and Graphics areas relate to one another as a suite of rooms grouped around the central space. This central atrium space accommodates the common resources of design areas, storage and lecture space and information access for pupils. It operates as a major overflow to the design studio and multi-materials spaces. The multi-materials spaces are partially separated by the heat bay and the plastics area. Joined by the technician's base, the other side of the central resource area accommodates a series of spaces for electronics, computer aided machine technology and design. The rooms on either side of the atrium act as two separate suites of spaces, connected through each other as well as via the central space. Pupils have access to materials in the technicians' base via a hatch. The base is located for easy access for materials being delivered from outside.

Fig. 35
Ground floor plan of phase I rooms at Kingsherst CTC showing furniture layouts.

Key

1. Preparation
2. Moving Storage Shelves
3. LabAF Control Unit
4. LabAF Science Laboratory
5. Shared Work Area/IT Resource
6. Interactive Video
7. Staff Room
8. Lift & Stairs
9. Dataview/ Display
10. Design/ Graphics
11. Woodworking
12. Craft/Multi Media
13. Technology
14. Plastics
15. Heat Bay
16. Computer Lathes
17. Metalwork Area
18. Store
19. Display

8. Business Studies, Home Economics, Art, Design and IT spaces are all grouped together on the ground floor of the adjoining block and easily accessible from the other areas. Thus there is room for expansion of the technology spaces because they are not constrained by being located all in one block.

9. There are good links with science, which is located above the main technology accommodation and exploits the use of a mezzanine area for shared resources which links down to Technology by a spiral staircase.

10. Unlike Djanogly CTC, which was a new build college, the technology spaces at the **Leigh** CTC in Dartford were constrained by the limitations of an existing block. In spite of these constraints, the refurbishment of this block has been achieved using a design strategy similar to that described for Djanogly.

11. The technology provision at the Leigh CTC is largely accommodated in a small block which is of a later period than the main school buildings. The theme of centrally located resource, lecture and study areas is similar to that

Three-dimensional models and 'hands on' experience gives pupils a full involvement

at Djanogly. Some of this central accommodation has been created out of a small open-air courtyard.

12. The Art rooms are in the adjacent main block of the College, connected by a short walkway. The Home Economics spaces are above the Art rooms. Access to Home Economics from the Technology block has been constrained by the limitations of the existing building, in that it can only be gained up a fairly narrow flight of stairs, but it is at least physically close to the Technology block.

13. Business Studies is also on the Lower School side of the split site, but in a separate block adjacent to the main administration.

14. The educational philosophy at **Kingsburst** was to split the Technology accommodation into three distinct areas. In Phase I Technology accommodation, there is a central space, used as a clean area for design and for modelling, and also as a base for teaching a full group away from the practical areas. It is glazed on three of its sides to provide good sight lines to the multi-material spaces surrounding it, to develop the feeling of cohesion with the whole suite, and to provide an area which is free from the noise and dust of practical work. It has an entrance on either side to allow easy movement through it.

15. The heat bay is formed from a part of one of the multi-material spaces, and is simply separated by a rail from the surrounding area rather than being enclosed.

16. The Technology space in the first phase is adjacent to the preparation area, which also doubles up as a resources area for the pupils, who are free to use a part of it if they wish. The whole of the

Fig. 36. Floor plan showing furniture layouts of Emmanuel Design Technology area

Key

1. Technology workstation and operator's chairs
2. Workbench and stools
3. Study table and chairs
4. Tall storage cupboard
5. Wall bench
6. Cantilever wall bench on castors
7. Non-magnetic whiteboards hung on rail
8. Pin board hung on rail
9. Coat hooks hung on rail
10. Shelves hung on rail
11. OHP trolley
12. Acoustic screens
13. Mortising machine
14. Double ended grinder
15. Super chamois polisher
16. Pedestal drill
17. Wood lathe
18. Sander
19. Bandsaw
20. Metal lathe
21. Milling machine
22. Sharp edge
23. Planer
24. Circular saw
25. Sheet saw
26. Strip heater
27. Convection bath
28. Fluidising bath and accessory
29. Blown suction unit
30. Brazing hearth
31. Acid pickling bath
32. Brazing hearth/forge
33. Crucible furnace
34. Mould bench
35. Welding bench
36. PCB unit

Food preparation and food technology is one of the variety of subjects covered under 'Technology'

prep area, which is also the technician's base, is considered by the users to be small, especially as it also doubles up as the science prep area. Storage problems of materials and equipment have been partially overcome by the use of sliding storage units. There is a separate metals and wood store for raw materials.

17. The design studio opens off the Technology area. The Art and Multi-Material spaces are directly above the Technology accommodation on the second floor of the phase I block. Home Economics, located on the first floor, provides another Technology area with links to the science laboratories on that floor.

18. The Technology accommodation in Phase II consists of a 3-D art room and a Technology room. The Art room is also used for pottery and the Technology room for robotics.

19. At **Emmanuel CTC** the Technology and Science accommodation span two blocks, with Science on the first floor and Technology on the ground. Despite the fact that the accommodation is split between two blocks, the close links created by the ribbon circulation achieve a strong feeling of continuity. Thus although the design could have accommodated all the Technology in one block, on two floors, the project team were keen to put the emphasis on ease of access from the preparation area.

20. Because the Technology accommodation spreads into another block, it can be extended or, indeed, contracted as necessary without constraints being imposed by the desire to keep all the suite within one block. This is also true at Djanogly and is a point worthy of consideration when designing a Technology suite.

21. The accommodation of Graphics Design rooms, Art spaces, and Multi-Materials spaces is well related geographically and it is easy to move from one space to another. Large openings rather than doorways do much to facilitate this, although some enclosed entrances are necessary in spaces which are particularly dusty or noisy. The central atria act as useful resource areas for individual and group work.

22. The Home Economics accommodation is upstairs, above the Multi-Materials accommodation. Emmanuel has been particularly successful in providing an element of open plan, whilst still providing defined specialist spaces.

23. Business studies and IT are both taught in suites of rooms in another block, but access to the Technology block is still straightforward because of the ribbon link.

Technology in the National Curriculum

24. The introduction of Technology as a foundation subject in the National Curriculum is having an increasing influence on the design of Technology provision in CTC's. The National Curriculum subject 'Technology' covers most elements of the old subjects of CDT, Home Economics, Business Studies, IT and Art and Design. Under the National Curriculum, all these subjects will need to contribute towards the development of the necessary skills, knowledge and understanding which pupils need to achieve the Attainment Targets through Programmes of Study for Technology.

25. A major difference between CTC's and other secondary schools is likely to be the greater time allotted by CTC's to Technology (about 20%) and, as a consequence, the likelihood of a more significantly developed variety of options within the curriculum.

SCIENCE

1. With Technology, Science forms the basis of the curriculum emphasis in the City Technology Colleges. In some respects, however, the accommodation issues are not as complex as for Technology, especially in Colleges using existing buildings. The National Curriculum subject Technology has been required to make curriculum links between a number of subject areas which were previously unrelated, such as Business Studies and CDT. By contrast, the content of National Curriculum science is closely related to the traditional science subjects of chemistry, physics and biology, and historically the spaces for these subjects have been grouped together.

2. The target for curriculum time in Science is 20% for all pupils in CTCs. In other schools the full National Curriculum science course will occupy about 20% of curriculum time, but most other schools are likely to have some pupils taking the shorter science course available under the National Curriculum. In the main the CTCs have approached Science through the provision of non specialist laboratories. The distinctions between the separate sciences is chiefly one of equipment. The move towards the use of one or two central preparation rooms means that specialist equipment can be moved by trolley to service the needs of a particular lesson, thus lessening the need for highly specialised spaces.

3. The key note of Science provision in the CTCs, therefore, is flexibility of use, which means that spaces are not tied to a subject area such as chemistry, but can be changed around as the teaching of the curriculum dictates. The main factor which makes such flexibility possible is the choice of furniture and equipment.

Labkit system

4. Traditionally, gas and water services have meant that Science laboratories have been equipped with fixed perimeter benching and fixed rows of benching in the centre. This creates a very rigid teaching environment. The move within the CTCs has been to select laboratory furniture systems which are not permanently fixed to the building but use relocatable service connections to allow rearrangement. Two examples of this approach are the Labkit Workstation System and serviced bollards with loose tables.

5. In the first phase of Kingshurst College the decision has been taken to use the Labkit system. Labkit is a totally demountable system which requires no floor or overhead servicing, so that it can be erected in a bare classroom over a weekend, and removed as quickly if required. The services run from a single service module, and the units daisy-chain on to this. The service unit need not even be in the same room: two adjoining rooms can share the same unit.

6. Labkit is particularly useful where a building programme is phased, and the requirement for a space to act as a laboratory is temporary, as there is no need to provide services within the building fabric. (see Design: para 10).

7. Kingshurst CTC has used the versatility of Labkit to create completely different layouts in each laboratory. The design has also used colour to emphasise the difference between each

Science is emphasised in CTCs, with pupil involvement in experiments and research.

space. The most successful arrangement is perhaps the 'horseshoe' layout which provides excellent opportunities for the teacher to observe and help pupils, with access from both sides of the bench, or to demonstrate or teach from the centre of the circle without the children having to leave their places.

Service bollards

8. Service bollards were first used in a CTC at Djanogly and subsequent colleges have also adopted the system to a greater or lesser extent. The system is of serviced bollards, with moveable tables around them which can be arranged in different configurations. Whilst the service bollards are to some extent fixed, the services in the floor can be capped off and covered and the bollards removed so that the room can be converted to a general teaching space if required.

9. This system is not quite as flexible as Labkit in that the services need to be in place for the bollard system to work - so it cannot be used to convert an unserviced space into a laboratory. Nevertheless, once the services are installed, the bollard system is perhaps more flexible than Labkit, and the mobile tables can also be used as perimeter benching (see also chapter on Design).

Other Systems

10. Some of the CTCs, more particularly the remodelled projects, have elected to keep fixed timber benching systems where they were still in good condition, but an advantage of new systems is in their use of the new solid laminates, which have the same maintenance advantages as solid wood but which offer far greater variety of colour and design.

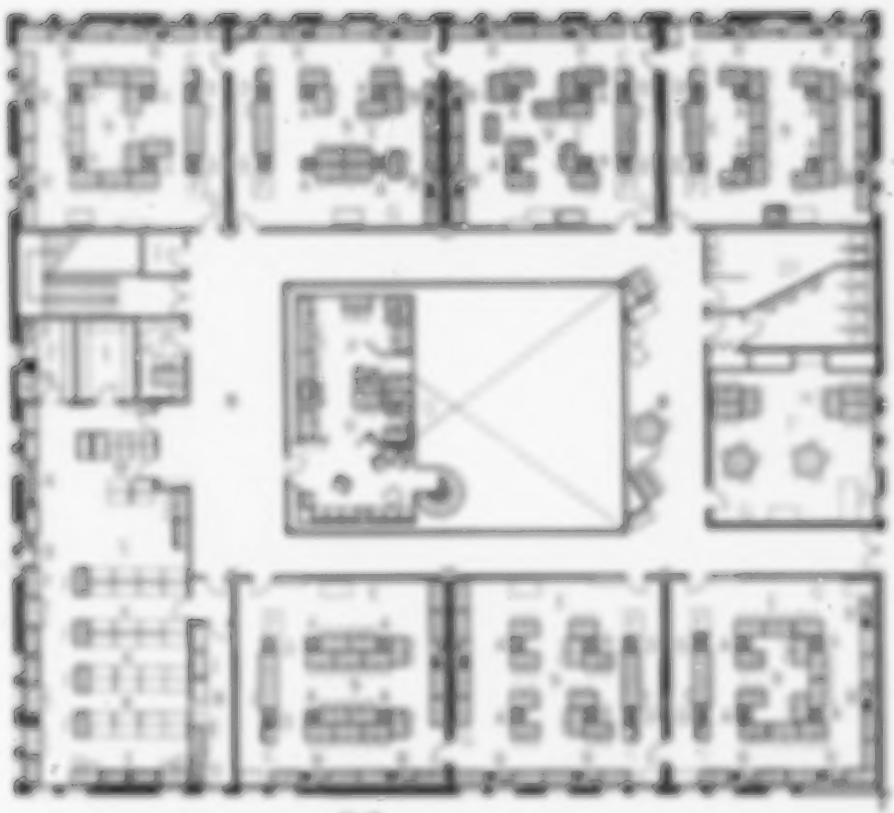


Fig. 17 Upper floor plan showing furniture layout of Djanogly science rooms.

Key

1. Store
2. Microbiology
3. Head of Department
4. Workup and workshop
5. Preparation
6. Projects Computer resistance
7. Science and Technology Staff
8. Animal Room
9. Science Laboratory
10. Toilets
A. Serviceable Service Bollards via footbox
B. Units of 600 x 1200 standard Tables.
C. Tutors Computer
D. Tutors 600 x 600 Bollard, with IT network outlets, and special connections for fume cupboards
E. Standing 1,200 x 600 x 850 high Laboratory Tables
F. Movable Fume Cupboard with other technical provision
G. Trunking to all walls with wet and dry services.
H. Standard height Tutors Table.
I. Equipment Trolley (parked position)
K. Demountable Storage Sheets
L. Sink
M. Fixing Cabinets
N. Transfer Chamber
P. Computer Server.
Q. Screens Fixed to Balcony Rail

OTHER LEARNING SPACES

Shared Study and Resource areas

1 An important aspect of the accommodation for 11 to 18 education is the provision of facilities for less formal learning. This can be achieved in two main ways, by small study areas and tutorial spaces, and by shared resource areas. Such spaces can be considered, at least in part, as untimetabled and informal. Their use is intended to encourage individual or small group study, either as an extension of a lesson or in free time, to develop a piece of work and to reinforce cross-curricular activity. This approach is an important objective of the CTC programme - equally valid for any secondary school - as it helps to develop the important characteristics of self-motivation and initiative. The physical characteristics of these spaces will vary and there is no ideal.

2 **Small study/tutorial areas** are best wholly untimetabled and might be spaces inside or close to the library or near to the formal teaching spaces, so that a minimal level of supervision can be provided. They might be a series of small spaces to accommodate one or two pupils working together at a table separated by low screens, or a larger space accommodating a group of 10 or so pupils.

3 One way of creating such spaces is through bays created off circulation routes. The new-build CTC's have greatest opportunity to achieve this and Djanogly and Emmanuel Colleges have exploited the first floor balcony areas around the atria spaces quite effectively for this purpose. The 2nd phase of Kingsdown has also incorporated useful study spaces at intersection points of narrower corridors.

4 Although more restricted in opportunity the remodelled projects have all given this requirement high priority, for example, the creation of glazed alcoves off the main circulation route at Macmillan, and the imaginative use of small alcoves off the ground floor circulation route in phase I Kingsdown.

5 **Shared resource areas** can be the key to cross-curricular linking. This can be within a faculty suite such as Technology, as demonstrated in the ground floor atria spaces at Djanogly and Emmanuel, or between subject areas which have been separated by the physical characteristics of the building.

6 Bradford College has used this device through the partially timetabled IT room located at first floor between Science and Technology. Also at Bradford, a shared resource area in the Humanities and Languages block affords easy access by pupils and staff. Work can progress with quite large numbers moving in and out of the area from surrounding spaces, all easily supervised informally by the staff.

7 Most of the refurbished projects had less scope to introduce large, central resource areas, but as at Leigh College great attempts have been made in the Technology suites.

Library

8 The visits demonstrated that CTC's perceive their libraries to be not merely a store for books, but the most important learning resource area in the building.

Shared study spaces are created at Djanogly CTC by movable screens within a wide circulation area.

At Bradford, students use laptop computers and library material in groupwork or at group work.

Most CTC librarians act as library and information service managers, often teaching whole groups within the library space. In addition, pupils working on their own need guidance on their own particular projects and small groups may need some direction in their set task. Generally, the librarian is adopting a wider role, including teaching, within the colleges.

8 The library is a major part of the information system, linked to the college's IT network, and monitoring the whereabouts of library material out on loan.

10. It is important for the library to occupy a central space in the college, so that it can be easily reached from all parts. All curriculum areas require access to library material at some stage. Ideally, it should be visually linked to the main circulation or reception area.

The amphitheatre in the hall of Bradford college makes an effective tutorial space for music and drama.

Music and Drama

11. Although the City Technology Colleges place a considerable emphasis on the teaching of Science and Technology, Music and Drama also have a very important part to play; not only in providing opportunities for teaching the technological aspects of the performing arts, but also for developing the social skills of the pupils.

12. Macmillan and Emmanuel have chosen to combine a larger assembly space with the drama provision, but at the other CTCs visited, dedicated drama spaces have been provided.

13. Sophisticated control equipment is often used to provide a very high standard of technical production. At Djanogly fold away staging is provided for building up seating for 'in the round' productions or to create stage areas.

14. Bradford's drama space, with an open control gallery and 'Juliet' balcony, provides an educational studio atmosphere, with full height, acoustically sealed sliding doors opening onto the adjacent dining space and offering a flexibility for performances or public functions. The provision at Emmanuel is an area doubling as an assembly hall, allowing a large audience to be accommodated.

15. Djanogly uses black curtains around the square double height studio to divide the space or create different dramatic environments. Opening the curtains enables a white wall to be used for cyclorama or projection from the control room.

16. In a number of the CTCs visited, the drama and music facilities were located next to each other. At Djanogly they were separated by a series of rooms including a recording area which allows music to be recorded from a soundproof booth or the music room, and then played back from the same equipment into the drama space, if required. This suite of dividing rooms gives good sound attenuation between the spaces.

17. Music spaces benefit from having as large a volume as possible to increase

Fig. 26: Furniture layout of Djanogly college library, reprographics area and computer room.

Key
1. Library
2. Issue Desk
3. Magazines
4. Control
5. Reprographics
6. Systems Manager
7. Computers
8. Purpose Built Library Desk
9. Security System
10. Low Tables & Upholstered Seats
11. Computer Tables
12. Heavy Duty Tables
13. Reading Tables & Chairs
14. Library Double Side Shelving
15. Library Single Side Shelving
16. Book Rack
17. Photocopier
18. Special Reprographics Equipment

the reverberation characteristics. *1 One way of achieving this is to omit the ceiling panels, and leave the underside of the roof open to the space. When Bradford CTC was visited, the central mall was seen being successfully used for music tuition.

General Teaching Areas

18. The keynote to designing general teaching spaces must be flexibility. Many of the CTCs have used a top rail system which, with the use of stand alone furniture and storage, allows the orientation and layout of the teaching

Perimeter trunking in all classrooms allows movable equipment such as computers and projectors to be used, while top-rail systems afford flexibility of shelf and white-board positions.

space to be changed to suit the type of teaching. Fixing pinboards to two or more walls can provide the same facility in a more limited way. The use of perimeter trunking allows serviced equipment, such as computers, televisions and projectors, to be relocatable. This is particularly important if equipment is shared by the whole college.

19. General teaching spaces can interact more fully with shared resource and other teaching areas if walls adjoining corridors and circulation spaces are glazed or left open.

Sport and PE

20. Facilities for outdoor sport and PE create a heavy demand for area *2. The provision at the CTCs visited ranges from that at Kingshurst CTC at 24 acres, to the Djanogly CTC, which with a site of only 4.5 acres is obliged to make arrangements for playing fields elsewhere.

21. The inevitable consequence of the city location of these Technology Colleges is that large sites capable of accommodating the College's own playing fields will not always be available. Some compensation for this may be gained by sharing facilities with other organisations, and thus developing both community and industry links. Many of the colleges have used "all weather" surfaces allowing a more intense use of outside play areas.

22. Within the building envelope itself, the provision of sports facilities across the CTCs has been fairly uniform. Most have, or plan to have, a sports hall, and the remodelled projects have often inherited a gymnasium. A number of the CTCs have also introduced the increasingly popular multigyms, which again offer opportunities to develop community links and generate income.

23. Emmanuel College has developed a strategy of combining the drama and assembly space, which also has provision for netball, basketball and similar activities. The semi-sprung Granwood flooring makes such diversity of use possible. This strategy has allowed the provision of an aerobics/dance room, which the College considers ideal for community use.

'All-weather' pitches at Djanogly College allow a small area to be more heavily used.

*1 Reference should be made to Building Bulletin 51, 'Acoustics in Educational Buildings' (1975).

*2 Reference BB 79 'Playing Fields and Hard Surface Areas' (second edition) 1982.

ANCILLARY AREAS

Assembly Spaces

1. There was general agreement that a space large enough to take at least half the college was an advantage. Some of the building solutions had identified other priorities, such as the Mall at Bradford, and the facility to have joint use for assembly or resources in the atria spaces at Djanogly.

At Djanogly CTC, a central atrium is used for assemblies and lectures

2. There was divided opinion as to the necessity of assembling the whole college on a regular basis - only Leigh CTC considered this as important, in order to counteract the split site characteristics of the college. All acknowledged that a space such as the sports hall could be used for whole college assembly if required, and a dedicated space would be a luxury rather than a necessity.

Circulation

3. The areas shown for circulation in the datasheet show a range of between 13.6% and 24.7% of gross floor area. The target for the CTCs is 10% of gross floor area, but this was intended to represent the figure for actual circulation, without taking into account the elements of extra curriculum area that those CTCs with the higher percentages have also included. These elements largely take the form of small study accommodation, and drama spaces. This approach serves the double purpose of providing curriculum spaces in an exciting, stimulating way whilst allowing circulation to be wider and more airy than if a more rigid segregation of spaces was designed for.

4. Of course, this approach has implications with regard to safety and escape requirements, and careful consideration of these factors should always be given during the design stage if circulation spaces are to be developed in this way.

5. In the new build colleges every attempt has been made to keep main circulation areas as generous as possible. Bradford has laid particular emphasis on its central Mall. Clearly the opportunities offered for other activities in this space make it much more than just circulation. However, in moving from the main spine to the individual blocks, ancillary routes contrast uncomfortably with the spacious feel of the Mall. Emmanuel and Djanogly utilise alcoves and bays along connecting routes and the balcony areas created by the Atria design combine circulation with small group study facilities.

6. It is interesting that the existing buildings in the main reflect the constraints of the original designs where double loaded corridor, multi-storey blocks have kept circulation to a minimum. This demonstrates that such building plans give less scope for variety of learning spaces along circulation routes which become just corridors.

Reception

7. Each of the colleges make a celebration of the entrance which reflects the importance they attach to establishing an image of an efficient and business-like organisation for any visitor that enters. Generally much more open reception spaces have been designed, often with staff accommodation immediately behind or closely associated with them so that staff can be completely in touch with the whole operation of the college. All six are illustrated here to demonstrate the approach each has adopted.

Catering

8. One interesting innovation evolving from the CTC programme in respect of catering is that of payment for food. Djanogly began with a magnetic card system - similar to phonecards - but has now developed their own system of card charging over the IT network. Emmanuel College have plans to take the idea much further. The tills will be linked into the IT network and all

Kingshurst CTC entrance foyer.

Reception area at Djanogly CTC.

At Macmillan CTC, the reception desk is reached via a shallow ramp.

'Hi-tech' reception desk at Bradford.

In Emmanuel College, the reception desk is in a central atrium space.

The main reception at Leigh CTC is on the east campus.

purchases are debited to the pupils' own account. Pupils at 11 will gain experience of budgeting and handling their own finances. Potential for dietary intervention is considerable, as every purchase is recorded in detail.

9. The approach to food preparation and delivery is varied in the CTCs, from full traditional preparation through convenience food to cook and chill or cook freeze systems. Due to the smaller numbers involved, full economic viability of the systems have not yet been demonstrated. However at least two colleges have been very satisfied by their experience of contracting the services into the commercial sector.

10. Earlier assumptions of 60% take-up of meals have been overtaken by the philosophy of most colleges where children do not go home and there is up to 95% take-up of the breakfasts and lunches offered.

11. Emmanuel College and 2nd phase Kingshurst have benefited from the experience of the earlier projects and been able to provide areas for dining which accommodate the needs of the high take-up in terms of area and fast through-put.

STORAGE

Curriculum Related Storage

12. Storage is an issue of some considerable importance in all schools, not less so because of the introduction of the National Curriculum. Apart from particular considerations arising from their emphasis on Technology and Science, CTCs are facing the same problems as all other schools in the secondary sector in trying to accommodate the storage needs of new teaching methods. These focus much more on continual assessment and a more practical approach towards subjects.

Preparation rooms at Kingshurst use movable shelf storage, but only at ground level due to the weight of closely stacked equipment

Timber mitre-stable lockers hung on movable screens allow easy maintenance and repair

13. Almost without exception, storage was highlighted as a problem area by the CTCs. However, there are a number of options which have been deployed in the CTCs in order to provide adequate storage space for all the project work, both in progress and waiting for assessment.

14. The use of sliding storage units, particularly for long term storage of project work, is very economical on space although the units are expensive in terms of initial outlay. It should be noted that, as these units are very heavy they are often unsuitable for use on upper storeys unless floors are specially strengthened.

15. Some teachers may feel they want the students to take their work home and return it to school only for assessment. Equally, really efficient management of existing storage space can considerably increase its capacity. Although potentially time consuming for teachers, it should be possible to involve the students in this sort of responsibility.

16. There is also a need to store raw materials and resources. Preparation areas and technicians' bases can be used for this purpose and they should be designed with this in mind wherever possible.

17. In general, large scale preparation of raw materials in schools is on the decrease and many materials are bought in ready prepared. However, it should be established early on whether items such as planters are to be used, so that the necessary room can be provided.

Personal Storage

18. At every CTC visited storage of pupils' personal belongings is perceived as a problem. Pupils seem to prefer to carry a sufficiently large bag to accommodate all the equipment and material needed for the day. Thus each pupil will carry a bag from lesson to lesson. They are also likely to carry their coats, and possibly other personal belongings such as sports equipment. Most CTCs manage the accommodation of these items within teaching spaces by allowing the pupils to leave their bags under their desks during lessons; many have provided hooks in each space for coats. The use of the tutor room as a repository for coats and bags, with 'bag parks' by the door, has been taken up by one college.

19. Clearly, pupils do not carry all their personal belongings with them all the time, and thus there is also the problem of longer term storage. The CTCs have approached this in different ways. Some have deliberately avoided having lockers, and expect the children to take belongings home and bring them in as required. Others have elected to use the locker system, and these are being used with varying degrees of success. The experiences of the Colleges which have been open for a year or more indicate that the lockers are most successfully used by post 16 pupils.

20. Storage, especially longer term, inevitably has security implications. In general, CTCs have not suffered greatly from theft and vandalism, despite the fact that the pupils are increasingly working without supervision. The Principals at the

Colleges attribute this to the fact that the children are responding to the expectations the staff have of them, and to a higher overall level of security, both in the initial design, equipping and, most critically, in managing the colleges.

21. Architects and Building Branch have recently published their research on aspects of storage of pupils' belongings.* The main conclusions from this work are as relevant to CTCs as to other secondary schools and some of the points are thus reproduced below.

a. In general it would seem that a significant proportion of children would like to have a locker and that they would use one if they had one.

b. Vandalism and theft, and normal wear and tear, is normally targeted at the doors of lockers and the carcasses are in any case well protected (except on the ends of runs). When selecting lockers, careful consideration should therefore be given to doors, locks and hinges.

c. The degree to which lockers are used depends on the individual school day, the design of the school and the location of the lockers. If the pupils' route round the school to lessons, lunch and recreation, does not take him or her close to their locker at some point then they are unlikely to use it. Lockers in classrooms or near some form of supervision are less vulnerable to vandalism or theft but those in classrooms are more difficult to use if the room is being used by another class. Lockers in banks can be difficult to use if they are all used at once, eg at break time.

d. Pupils attempt to break into lockers because the owner has lost the key, to remove the contents, either to steal them or to 'borrow' a book or piece of equipment, or as a pastime during breaks.

e. The different types of security system (keys, padlocks, combination locks) need consideration. There is no clear favourite but padlocks seem to be the most effective in terms of ease of administration and locking effectiveness.

f. Broken lockers or personal storage without a locking facility are very rarely used by pupils in schools. This includes locker desks. However, it may be possible to re-educate users towards an ethos of trust and responsible behaviour.

g. Bag racks and coat pegs in classrooms can be made to work very effectively but it is important to remember that the pressure upon such facilities when fully used will be high.

Staff Accommodation

22. The organisation of staff accommodation at the CTCs was very much subject to the influence of the Principals. Some felt that the provision of a central area where staff from across the college could meet to discuss cross-curricular work was of great importance. Others favoured the approach of satellite work areas for faculty or department staff, using one of the large spaces in the college for occasions when all the staff needed to meet together.

23. It was generally agreed that the Principal needs to have a private, and moderately prestigious office, as they are the first point of contact with potential sponsors and representatives from the local community and industry. Opinion on the provision of offices for senior staff was again divided - some felt it cut the staff off from the pupils, whilst others saw them as great morale boosters for the staff.

24. The colleges also require office space for those functions not being carried out by an LEA - for example, each CTC needs a bursar, to control aspects of the financial running of the college.

Technicians and Preparation Areas

25. Most of the CTCs have a team of technicians supporting teaching across the whole curriculum, particularly Science and Technology, and including IT. In Science, a central prep area is desirable to service all laboratories, using trolleys for transportation of equipment. This has the advantage that equipment need not be duplicated, and is economic on the technicians' time and space. It is clearly preferable to design for all the spaces requiring servicing from a prep area to be on the same level. Alternatively a lift nearby can also solve the need for disabled access.

26. In Technology, the technicians' base is becoming a 'shopfront' for pupils to choose materials from the store. A central and single space also means that only one technicians' office area is required. As with the librarian, the role of technicians is changing so that in many of the colleges they now have a major supporting part to play. This is particularly true for Technology and Science, but applies to other areas as well - as subjects such as Humanities and Maths become more practically based, and pupils are working more independently on individual projects.

SERVICES

1. Traditionally the level of funding for building services in secondary schools has been a reflection of the relative lack of sophistication required. The CTC projects have shown a range from 24% to 32% of gross building costs for provision of services. The generally higher level for the new-build projects reflects the increasing sophistication now being experienced. This has come about due to demands of new technology, the need for improved environmental control and an increase in demand for workplace services. These aspects are discussed in more detail in this section.

ENVIRONMENTAL CONTROL

Ventilation

2. Priority is given to low maintenance in both provision and cost, and naturally ventilated buildings were logical objectives to satisfy this. However, the trends in planning towards deeper buildings, which facilitate cross curricular activity through a series of connected spaces, are putting pressure on the physics of natural ventilation.

3. Deep plan pavilions generated at Djanogly College from the curricular demands, have largely remained naturally ventilated by "stack effect", created by the tall central atria. Generally speaking, relatively deep perimeter spaces like this can benefit from the natural draw of rising warm air in the central atrium and facilitate cross ventilation from windows in the outside walls. This is similarly applied in the smaller pavilions at Emmanuel College in Tyneside, where fans are used at high level, to re-circulate warm air at certain times depending on the temperature. The sectional profile of the main teaching blocks at Bradford, often utilising double-height spaces to create visual links between floors and let light into the building, also assists natural ventilation through stack effect and a larger room volume. Kingshurst, Leigh, and Macmillan Colleges all use refurbished system-buildings, where the original form was generated by the accepted principles of naturally ventilated buildings; two six metre deep classrooms either side of a corridor. This plan form has good single-sided ventilation, but has not allowed these colleges the educational and planning advantages offered by deeper plan buildings.

4. A few spaces in each of the colleges have required some mechanical ventilation, for example toilets, changing rooms, kitchens, dark rooms and some science preparation areas. The principal reason for mechanical ventilation is the large number of air changes required; so by locating most of these spaces internally, the learning spaces can benefit the most from natural ventilation and daylight from external walls.

Lighting

5. The lighting levels all comply with DES Design Note 17[1], but vary quite considerably, as can be seen from the datasheet (page 74). All the colleges, particularly those newly built, have aimed for quality lighting which has created pleasant learning environments. Some task lighting is

Rightmost windows in the double height spaces at Bradford CTC allow a 'stack effect' of warm air rising and circulating.

Lighting is inset into the ceiling with baffles to prevent glare. Djanogly CTC also has a 'service' at ceiling level to service heavy machinery.

provided for machines in Technology and in Science areas. Most of the colleges have used fluorescent fittings recessed into the ceiling, with baffles to avoid glare, and in most classrooms lights are switched in rows parallel to the windows to maximise energy efficiency.

Heating

6. All the CTCs use gas for heating. To save energy most colleges have installed direct gas fired storage heaters for hot water generation with pumped circulation. This allows the main boilers to be switched off outside the heating season with significant energy savings. Bradford and Emmanuel CTCs used smaller local boilers in each block, with the advantage of simpler installation and maintenance. Some further energy saving was also gained in Bradford through the use of condensing boilers. All colleges used radiators, and most used some fan convectors. The number of heating zones varied from one to eight, the average number being three. The control systems all featured weather compensation, optimum start and frost protection. Some colleges have taken out annual maintenance agreements to cover the boiler plant, heating and kitchen equipment.

Energy management

7. There is a natural trend towards energy efficient buildings, both in terms of their initial design and in controls to reduce wastage of fuel in use. All the colleges discussed comply with the guidelines of DES Design Note 17[*1] and surpass them to the extent that they are below the maximum annual energy consumption value (AECV) quoted in DN17 by between 30% and 50%. All comply with the U-values in the current Building Regulations with the exception of Dartford, which is a refurbishment of a SEAC construction with large areas of single glazed metal windows. Macmillan was also a refurbishment of a system building but was brought up to the current U-values by replacing over 50% of the original glazing by insulating panels. Some of the colleges used double glazing both for windows and rooflights.

8. Advice from the DES was to incorporate some form of 'intelligent' control through an Energy or Building Management System. Five of the six colleges visited use EMS or BMS. This can extend the usual timer and temperature controls on different services to include, via a central computer console, overriding control of lighting, ventilation and heating zones and monitoring of plant, fire and intruder alarms. Some manual adjustment of the control parameters is required, but the system can also incorporate optimiser controls that learn from previous conditions and make adjustments automatically. With the emphasis on technology they also have potential as an educational resource in the colleges. Further conservation measures include pressure flow control on urinal cisterns and timed flow on taps. In one case the consumption of water is monitored by the BMS.

Security Systems

9. The huge increase in expensive equipment in schools, much of it electronic, has generated considerable interest in security systems. Of the six CTCs looked at only one has consciously avoided any of the newer electronic security systems. All have been aware of the advice given in DES Building Bulletins 67 and 69[*2], in considering the overall planning of the buildings whether new or remodelled. Together with sensible planning that avoids areas that cannot be easily supervised, all of the colleges have adopted external security lighting of some form, usually energy efficient sodium lamps. Djanogly has only a limited amount of free standing lights, mainly to illuminate the main entrance steps. However, introduction of lighting into the overhanging eaves provides modulation to the external walls and ensures that all windows or doors are illuminated at night. The deterrent effect is considerable. Overspill lighting provides effective illumination to nearby paths, avoiding the need for expensive and vulnerable lighting bollards or standard lamp lighting.

10. Inside the colleges use of security systems have all been based around the passive infra-red space protection system combined with magnetic sensors on all external doors. Various degrees of zone control and 'part-set' conditions have been adopted, depending upon the anticipated level of community or extended use of facilities within a college. Gone are the days when computers are wheeled into lockable cupboards at night. The CTCs have a target ratio of computers approaching 1 to 3 students. They are less likely to be accommodated in one or two specialist computer rooms but appear in all teaching and study areas

[*1] Design Note 17 "Guidelines for environmental design and fuel conservation in educational buildings". Architects and Building Branch DES, 1981, with annexes, lighting and thermal standards.

[*2] B & B Branch(?), publications titled "Crime prevention in schools: practice guidance" (DES) and "Crime prevention in schools: how to plan installation and maintenance of intruder alarm systems" (DES), 1985

	Kingshurst Phase I	Kingshurst Phase II	Quarry's Nottingham	Macmillan Taunton	Bradford	Crossmount Tyneside	Leigh Dartford
Lighting – General Description	A high quality 400z count was used with pleasing results.	A high quality 400z count was used with pleasing results.	Generally reviewed the brightness, fluorescent luminaires with specular aluminium reflectors, suitable for 400z use.	High frequency control gear is preferable to overcome stroboscopic effect. Specular and semi-specular reflectors. Diffusers for quality and lightness not to matching or shine due to cost.	Low energy lamp control e.g. fluorescent and compact fluorescent and 100% dimmable.	Classroom lighting compatible with requirements for 400z installations.	Refurbished areas, re-lit due to age of existing lighting and changing requirements.
Light fittings and Lux levels –							
General teaching	Phase I Low brightness fluorescent 500+	Phase II 1,000 recessed fluorescent 600	Low brightness fluorescent for 400z use. 400	Business studies low brightness louvres, other classrooms perimeter, perimeter, diffusers. 350, 400	Recessed semi-low brightness fluorescent. 400	Fluorescent recessed low brightness. 500	Single and twin fluorescents with diffusers for cell activities. 400
Reception	Phase I Low voltage. 400	Phase II Fluorescent tube pack. 750	Fluorescent or above and Low voltage 20 W downlighters.	perimeter, diffusers. 350, 400	Located in main entrance high low 500. 400	Fluorescent recessed low brightness & track spots. 400	Combination of general fluorescent with tungsten downlighters & floodlights. 250
Sports hall/ gymnasium	Phase I Low Bay 400 300	Phase II Suspended 1x1700 with reflectors.	Suspended 6x400 fluorescents with angle/mirror reflectors, emergency and lights.	reflectors & perimeter. 350, 400	Low pack 1700 1700. 400	Fluorescent. 400	300
Corridors	Phase I Upgrade & Low voltage. 200	Phase II Recessed 4x236 fluorescent & 1x236 upgrade. 200	Fluorescent 4x400 or pendant fitting & 4x400 sodium fluorescent/sodium downlights, medium fluorescent emergency. 200	perimeter. 200, 200	Low level fluorescent 2 x 4 x 200.	Fluorescent recessed low brightness with integrated emergency. 200	Fluorescent with occupancy control. 200
Security lighting	Phase I 2x75 floodlights building mounted with supplementary support column.		1x2700 high Pressure Sodium 1x2Mg recessed into eaves soffit, fitted with vandal resistant glass.	external 1x36 1x75 and high pressure & 1x1700 1x75 floodlight with incandescent control. 2 x 40.	Incandescent flood 1 x 1x75 1x75 2x75.	1x36 with infrared detection. Connected to floodlights.	Non maintained sodium fluorescent & security wall lighting.
Fire alarms	smoke & temperature protection	smoke & temperature protection	smoke & temperature protection	multi-line analogue addressable	Manual break glass alarm line.	automatic smoke & heat detection.	manual break glass units & smoke/heat detectors.
Trunking type and manufacturer	3 compartment plastic. MK Powerline.	3 compartment plastic. MK Powerline.	2 way aluminium Cope Profile Ring. 2 off & 1 off.	2 way, Cope Band 1 off setting, one compartment & four floor.	2 way, Cope, one type 1 compartment with circuit capacity. Cope with power cabling. Cope on the cross cable.	2 way, Cope Cable & power. Mfg.	2 way, Cope, one type 1 compartment with circuit capacity. Cope for power cabling. Cope on the cross cable.
No. of socket outlets in general teaching	10	10	1 socket 20 cross section 2 Outlets 4 cross	24 sockets/room	8 floor 4 Cross. 12	10 2 cross 1 cross. 1 socket	4 cross
Fume cupboards	Blown type	Mfg'd type	3 cupboards fitted	1 fitted type & 2 as recirculation	1 fitted	3 fitted. recirculating type	2 fitted. No Fitted & mobile type
Heating and controls	Phase I Central heating to entire school. Phase II 3 compartment trunking. MK Logics.	Phase II Electric convector heaters with 2 single pole 13amp switches.	Central heating gas fired boilers 1 circuit to 3 circuit 4 operation zone. Compensator. MK Logics.	central by 40 gas fired boilers. Radiators another compartment to control. MK Logics.	Centralised gas heated. gas, underfloor & insulation supplied & installed & zone heating. Honeywell. MK Logics.	Gas boiler type & 2 x 2 off the wall gas boiler. Heated throughout. Supplied & valve. 1 main 2 sub heat input. MK Logics.	Central heating & 2 x 2 off the wall gas boiler. Heated throughout. Supplied & valve. 1 main 2 sub heat input. MK Logics.
Areas with cooling	Entire Suite	Entire Suite	Whole Workshop Offices	Yes	Yes	No Heat Load	Computer suites, Offices

across the whole curriculum. The general approach of infrared protection to all ground floor rooms and circulation areas on all floors has proved both flexible and effective. Once a basic system is incorporated into the buildings, allowance can be made for its extension as needs arise.

11. At the more local level security systems to protect library books and other resources have generally been dealt with by electronic tagging. Coupled with sensors at the entrance to library and resource centres, this has proved an effective deterrent to pilfering. In the one college not using either infrared security or library security, they have operated a very successful responsibility and trust ethos amongst the students.

WORKPLACE SERVICES

Distribution of Services

12. There is an increasing demand for principal services such as water and power into more areas of the curriculum. However the greatest concerns, addressed in different ways by the six CIC projects, were provision of drainage and integration of IT networks. The first comes out of the need to commit the principal installation into the ground and under the buildings before construction can start. The second comes out of the relative novelty of application to school building and the very rapid progress in the field of information technology. The solutions for these areas represented the extreme ends of a general philosophy of adaptability followed in the projects, through both 'wet' and 'dry' services being accessible and extendable.

13. Djanogly college utilised the void above the suspended ceiling to facilitate distribution of the main supply services. A basic 'ring main' approach was adopted for each principal service using the ceiling void for both pipes and cables. The secondary distribution was heaviest in those pavilions where science and technology activities required it. This avoided the expense of all areas being highly serviced. However, the design allows services to be easily extended in other pavilions as functions change over time. Macmillan College inherited floor trenches which carried services throughout the corridors. The existing pipework and much of the wiring had to be replaced. Such encapsulation of pipework, particularly on the ground floor, considerably limits the longer term flexibility.

14. Both Macmillan and Djanogly Colleges have used the ceiling void of the lower floor to service the science laboratories on the upper floor. This stems from a general reluctance to accept island bedlands serviced from above, partly due to sightline restrictions. However, servicing from below relies on either all laboratories being on first floor level or the use of raised floors at ground floor. Raised secondary floors are costly and also limit flexibility, as there is little justification to provide them

The demountable 'Cubic' system has been used in the existing buildings at Djanogly CTC.

throughout the building with the associated problems of 'wet' services running beneath them. Therefore to achieve science labs at ground floor structural slabs must be lowered to keep floor finishes level throughout, or steps and ramps must be incorporated. At Bradford CTC the physical characteristics of the steep site have been utilised to generate a suspended floor in one block. This allows laboratories on the ground floor to be serviced from below without undue expense, although specialist areas are constrained to one dedicated block.

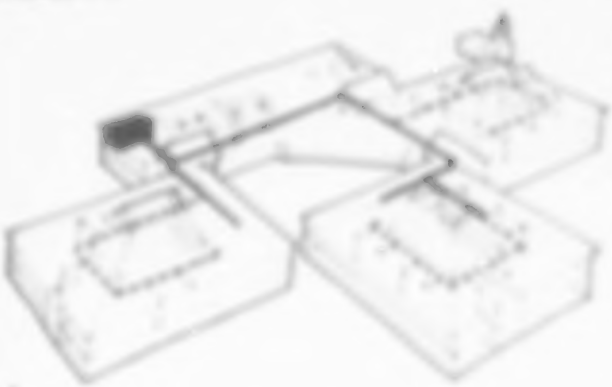


Fig. 10 Diagram of services strategy at Djanogly CTC

'Wet' Services

15. At Djanogly College a basic grid of drain outlets has been laid across the ground and first floors of all buildings. The design had to compromise total flexibility with cost and this led to a more extensive grid in those areas which would initially house more heavily serviced activities. As with most of the CTCs, exact layouts of spaces remained undetermined until late in the building construction programme. Maximum use of surface fixed internal waste pipes and a deep ceiling void to the ground floor allowed most layouts to be accommodated with the facility to change them easily in the future. Constraints of an existing building structure at Kingshurst 1st phase with restrictions on floor penetrations, were met by an extension of the adaptability philosophy. Here science on both ground and upper floors was provided for by installation of proprietary "Labkit Workstation System". This enabled one or two whole laboratories to be serviced by one control panel supplying gas, water and power via overhead trunking and extracting waste through vacuum suction by the same route. As a 'kit of parts' it has also been easily moved in phase II to create laboratories elsewhere.

16. Gas pipes can be a particular problem because they must be in ventilated areas so that leaks can be detected. Ventilated ceiling or underfloor voids have been used to hide unsightly pipes which would otherwise have to be exposed. Most colleges have used 'Gas Guard' or similar units to detect leaks or open taps by loss of pressure and then to automatically shut off the supplies.[1]

Local Extract

17. As a result of the COSHH[2] regulations extract of hazardous fumes and dusts must now be done at source. In compliance with this, Technology areas are provided with appropriate extract systems to metalwork equipment such as brazing hearths, welding benches, and forges (all generally located in heat bays), as well as plastics technology benches and woodworking lathes, planers, sanders and bandsaws.

18. In Science laboratories, fume cupboards are provided for some demonstrations and experiments. Some colleges have used mobile recirculatory units with disposable filters, whilst others have fitted more traditional fixed fume cupboards with ducted extract.[3]

'Dry' Services and Trunking

19. Whilst all CTCs used conventional electrical wiring from local distribution boards, there was also some use of busbar systems to save on installation time and to provide more flexibility in supply capacity. This also eases relocation of equipment. Some colleges provide three phase supplies to larger items of equipment such as kilns, lathes and circular saws. 110 volt supplies for hand tools in multi-materials have only been installed in one case, all others using 240 volt supplies. Workstations supplied as furniture often have in-built trunking containing low voltage provision for electronic equipment and compressed air for pneumatic experiments.

20. Generally, the number of socket outlets provided in teaching spaces is well above the average as electrical equipment, particularly computers, is heavily used. It is interesting to follow the increasing use of 'laptop' computers in some colleges and the apparently declining need for socket outlets. In all the CTCs, dado-level trunking has been used to locally distribute the power and hence most outlets, but the trunking, which often runs on at least two walls in every room, is more important for the distribution of the various IT networks used, and telephone and television cable. Where a broadband network system has been used, signals from satellite, aerials and video can be transmitted using the same cable as the IT network.

21. The services datasheet (page 7) shows the various trunking systems used. The choice depends to some extent on cost, but more importantly vulnerability to knocks and compartmentation. Some signals can suffer interference by the proximity of signal and power cables, so a metal divider between compartments is necessary. It is also important to set the trunking at a dado height which allows outlets to be above desk height, but is still below window sills and pin boards, etc. Some colleges have used short vertical runs of trunking to vary the height, another has fixed the trunk 50mm away from the wall so that white-boards and shelves, which hang off the trunk, cover up the trunking underneath.

22. In Djanogly and Emmanuel, the trunking has been fixed against a timber dado rail which also protects the wall at table and chair back height. Brackets on the external wall ensure

Dado trunking systems at Kingsburst, Djanogly, Macmillan, Bradford, Emmanuel and Leigh Heading left to right, top to bottom.

that a continuous gap is created behind the dado or trunking to allow convected heat to rise from radiators under windows. Djanogly also uses a triangular profile trunking in Science and Technology areas, fixed to the standard height dado rail. 600mm high, benching can be abutted and outlets are comfortably accessible above. A timber fronted compartment below also contains gas and water pipework feeding downward to moveable sink and gas-tap units. Vertical pipework is contained in the thickness of the outside wall, to avoid the problem of pipes crossing in the same plane. At both Djanogly and Kingsburst a "Powerpods" system has been used to deliver electrical, IT and signal services from the ceiling void to furniture located in the centre of teaching spaces.

The triangular profile of Knife Ang trunking at Djanogly CTC allows connects to run behind a panel beneath.

Power point, fixed between the floor and ceiling, allow island furniture bench to be serviced with power and IT networking.

INFORMATION TECHNOLOGY

IT

network has been added within the trunking to facilitate the use of a few IBM machines with good educational software for continuity of experience from the primary schools.

6. **Plymouth** has developed a unique approach to language work by integrating a traditional audio language laboratory with video and direct satellite TV and full IT facilities. Two members of staff can work with two full groups at any one time on a variety of work. They can monitor and intercede with the students' work. The language facility has become a wholly international centre. It can be used to improve English and many other languages, make direct contact via satellite broadcasts and call up comparative data on any country from the various software packages. From inspired early planning, this centre has developed by attracting extra sponsorship for the direct benefit of the children.

7. **St Thereslian College** the philosophy has been for laptops for all students from the very beginning. Students are encouraged to use their laptops for note-taking inside and outside the classroom and for their homework. This approach is an integral part of the teaching method with students becoming very familiar with the use of a keyboard. Problems of absorbing new students into the third or fourth years are anticipated because of their lack of familiarity, and some compensation by more recruiting in the 1st year to help keep numbers up if there are losses due to natural wastage.

8. Many more conventional computers are provided at St Thereslian College, with access also used as bulletin boards of general circulation areas. Under the control of an information services manager the college has adopted a broadband coaxial system, networking the whole school with Novell and IX. Net network software. This was acknowledged as more expensive but the extra facilities offered, including integrated video and data, justified the cost in the view of the Project Director.

9. **St The Bradford College** the use of IT is considered to be a major aspect of the link between the college activities and the outside world of business and industry. The main IT room has a high profile location. Almost suspended at 1st floor with a fully glazed curved wall, it dominates the main entrance and is a deliberate focal point for all those entering the college. The location and pattern of use of this room was carefully planned. Timetabled for around 30% of the time and with entrances from both the Technology and Science block, it is seen as a link resource for those subjects which are otherwise physically separated by the building configuration.

10. Bradford also took an early decision to adopt a broadband coaxial system for networking the entire college running Novell version 2.15. There are also a number of smaller local 'Server' networks linked to the main network. Using Olivetti machines, most teaching spaces are equipped with computers. The whole system is operated by a number of the teaching staff with particular interest and expertise. He has a small teaching load of eight or nine periods a week. The teaching background helps considerably the in-service training of the college staff that forms a large part of his duties.

11. **Emmanuel College** has an Ethernet network [illegible]. There are outlets in the majority of teaching spaces, in offices and in open access areas. Like Plymouth, Apple Macintosh have been employed. The connections into the network are through a simple single plug LAN connection to the Ethernet distribution. A development on the 'prep' suite available for Nottingham, which ensures continuity of the network. 8 machines are plugged in or disconnected. Two IT rooms are provided in the upper portion of the college. It is anticipated that pupils will use these spaces throughout their time in the college as part of the business studies suite.

12. **Leigh College at Dartford** has had a difficult problem to deal with, that of split sites. The network has been an important part of the link but at present the installations are separate and IX open working link using the phone lines. There are two IT rooms, one on each site. The Principal is quite sure that all pupils need to become competent in the use of information technology in the first year in order for them to be able to access the full curriculum that is planned. Computers throughout the college use an Ethernet based network system split into three

	Gateshead	Harrogate	Manchester	Bradford	Cirencester	Leigh
	Sunday	Nottingham	Tameside		Cirencester	Salford
Network type	200 Token ring throughout existing building. 10 Mbit/s Ethernet in new building. Fibre optic between buildings.	College wide ethernet based network running Novell network & PC-NFS.	Broadband, video & data integrated network running Novell network & PC-NFS.	College wide broadband network running Novell network & PC-NFS.	Novell Netware 286 version 2.2. Thin wire ethernet. Cabling in ducts under floor and in open areas.	College wide ethernet network with 2 servers and 1 gateway and 170 Novell terminals.
Personal computers						
For curriculum use by students	50 Archimedes 310. Others	12 Nimbus PC 186	400 Laptops, 286 & Turbo XT's & Archimedes. 25 BBC Master 128.	12 IBM AT 20 286 Nimbus PC Turbo XT's and processing at least 4 IBM AT's for Visual Art. 20 BBC Master 128 Student project Macintosh II's for graphic design	6 Sky Apricot Laptop 286's	
For use by staff			12 Viglen portables.		7 Sky Apricot offices. 30 Sky Apricot Mini's. 286	
For both library use & student use in Networks	30 IBM PC's	30 Apricot Mini's. 20 Apricot F1 286 PC's. Others.	30 Acorn Archimedes	1 Acorn Archimedes, Novell network gateway. Also Novell PC 286	2 Sky Apricot PC's. 1 Sky Portable. Mercury PC	10 Sky Quattro
Mass storage (hard disk)	Central storage on Novell network servers	Central storage on Novell Servers. Others	2 IBM PS2 Model 70's	Central storage on Novell Servers. Others	Central storage on Novell 40 Mbyte	8 x 40 Novell
Number of users	1 PC per 20 per for IBM	30 users per each one	Each has access to 30 in library	average 1 per room	1 PC per room	average 15 per each room 1 PC
Type of users	Open log in for IBM area in library	Novell PCN, Mac, IBM, Apple	Apple Networks	All use & Archimedes	Log in prior small type	Novell Log
Computer training						
Group Size. Time/week Staff	All Class sessions. Per 20	All 1 1	In Group Training	All 1 1	All 1 1 Per 20	All 1 1 per 15
Computer Use Facilities and Locations	Novell PCN in LIBRARY			1/2	1 per 1 PC in Library or in PC Training Room	1/2 PC
Staff	1 Library Manager. 1 Librarian. 1 Support Staff for 12 staff on 4 hours per week	1 Network Manager. 1 Network assistant	Head of Group. 1 Lecturer Grade. 2 Information Service Manager. Information Library Manager. Data Technical. 1 staff training. 1 data entry	Systems Manager. IT Technician	Network Manager. All other staff. Network use & general Manager.	Systems Manager. All other staff. Network use & general IT Technician
Current Software Developing	Software Source. Word Processor	1 manager	Developing Network Manager and others. Engineering			Library Manager. IT Technician. Student Assistant

domains with cross domain access. A separate administration domain has been set up. Cost justification was the main reason broadband was not provided, although this would have been preferred.

12. An important feature of Lyng's college is the 'International Centre' housed in the newest part of the original building that used to be the library. Unsurprisingly the centre has facilitated a natural extension of the college's international role. Not only does it serve as an important language and communications centre. Housed alongside the college boardroom and other facilities, it is hoped that this will be a major link with the local community and business. The centre reflects the international flavour of the college and has scope to develop even more.

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Following the completion of the first City Technology College (CTC) projects there has been considerable interest, both nationally and internationally, in the experiences of this innovative building programme which has aimed to inform briefing, design and construction for schools for 11 to 18 year olds. This publication, prepared by Architects and Building Branch of the Department of Education and Science, lays emphasis on building and accommodation aspects of the educational design initiatives taken.

The format and content of this Building Bulletin is intended to appeal to all those who are involved in provision for 11 to 18 year old pupils. It should be of interest to educationalists, education officers, governors, sponsors, architects, quantity surveyors, engineers and all who might be involved in the LEA maintained, independent, voluntary aided and grant maintained sectors and the continuing CTC programme.

The Bulletin consists of a series of self contained chapters which start by explaining the context of the programme. This is followed by a description of six building projects presented as case studies, with an explanation of how they were carried out. Chapters follow which analyse – by illustration from the case study projects – design considerations, characteristics of key learning and ancillary spaces, and finally an analysis of the building services that support delivery of the curriculum.

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